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ABBREVIATED TITLES USED IN THE ABSTRACTS

Abbreviated Title.	*Journal.*
Aircr. Engng	Aircraft Engineering.
Ann. Min. Belg.	Annales des Mines de Belgique.
Ann. Min. Roumanie	Annales des Mines de Roumanie.
Ann. Off. Combust. liq.	Annales de l'Office National des Combustibles Liquides.
Asph. u. Teer	Asphalt und Teer.
Auto. Engr	Automobile Engineer.
Auto. Tech. Z. (Berlin)	Automobiltechnische Zeitschrift (Berlin).
Azerb. neft. Khoz.	Azerbaidzhanskoe Neftyanoe Khozyaistvo.
Beitr. angew. Geophys.	Beitrage angewandte Geophysik.
Beitr. Geophys.	Beitrage zur Geophysik.
Bitumen	Bitumen.
Bohrtech. Z.	Bohrtechniker Zeitung.
Bol. Geol. y Min. (Caracas)	Boletin de Geologia y Mineria (Caracas).
Bol. Inform. Petroleras (B.A.)	Boletin de Informaciones Petroleras (Buenos Aires).
Boll. Soc. geol. ital.	Bolletin de la Societa Geologica Italiana.
BrennstChemie	Brennstoff Chemie.
Bull. Acad. Sci. (U.S.S.R. Inst. Seismol.)	Bulletin of the Academy of Sciences (U.S.S.R. Institute of Seismology).
Bull. Amer. Ass. Petrol. Geol.	Bulletin of the American Association of Petroleum Geologists.
Bull. Amer. geol. Soc.	Bulletin of the American Geological Society.
Bull. Ass. franç. Tech. Pétrol.	Bulletin de l'Association Français des Techniciens du Pétrole.
Bull. Inst. Min. (metall.) Engrs	Bulletin of the American Institute of Mining and Metallurgical Engineers.
Bull. Math. Phys. Éc. polyt. Bucharest	Bulletin de Mathematique et de Physique, Bucharest (École-polytechnique).
Bull. roum. geol. Soc.	Bulletin of the Roumanian Geological Society.
Bull. seismol. Soc. Amer.	Bulletin of the Seismological Society of America.
Bull. Univ. Texas (Bur. econ. Geol. Techn.)	Bulletin of the University of Texas (Bureau of Economic Geology and Technology).
Bur. Stand. J. Res., Wash.	United States Bureau of Standards Journal of Research, Washington.
Calif. Oil World	California Oil World.
Canad. J. Res.	Canadian Journal of Research.
Canad. Min. J.	Canadian Mining Journal.
Canad. Min. metall. Bull.	Bulletin of the Canadian Institute of Mining and Metallurgy.
Chem. & Ind.	Chemistry and Industry.
Chem. Rev.	Chemical Reviews.
Chem. Tr. J.	Chemical Trade Journal.
Chem. Wkbld	Chemische Weekblad.
Chim. e Industria	La Chimica e l'Industria.
Chim. et Ind.	Chimie et Industrie.
C.R. Acad. Sci. (Paris)	Comptes Rendus hebdomadaires des Seances de l'Academie des Sciences (Paris).
C.R. Geol. Pétr. (Strasbourg)	Compte-Rendu des Seances du Groupe des Geologues Pétroliers de Strasbourg.
11me Congrès Mond. Pétrole	11me Congrès Mondial du Pétrole (Paris, 1937).
Diesel Eng. Us. Ass.	Diesel Engine Users Association.
Direccion Minas y Geol.	Publication of Direccion Minas y Geologicas (Argentine).
Econ. Geol.	Economic Geology.
Engineer	Engineer.
Engineering	Engineering.
E.P.	English Patent.
Fuel	Fuel in Science and Practice.
Gas Oil Pwr	Gas and Oil Power.
Geol. Mag. (Lond.)	Geological Magazine (London).
Geophys.	Geophysica.

Abbreviated Title.	*Journal.*
Glückauf	Glückauf.
Groz. Neft.	Groznenskii Neftyanik.
Industr. Engng Chem.	Industrial and Engineering Chemistry.
Industr. Engng Chem. Anal.	Industrial and Engineering Chemistry, Analytical Edition.
Industr. Pwr & Fuel Econ.	Industrial Power and The Fuel Economist.
Instruments	Instruments.
Int. Z. Bohrtech.	International Zeitschrift für Bohrtechnik.
J. Amer. chem. Soc.	Journal of the American Chemical Society.
J. appl. Chem. (U.S.S.R.)	Journal of Applied Chemistry, U.S.S.R.
J. appl. Phys.	Journal of Applied Physics.
J. chem., metall. min. Soc. S. Africa	Journal of the Chemical, Metallurgical and Mining Society of South Africa.
J. chem. Soc.	Journal of the Chemical Society.
J. Fuel Soc. Japan	Journal of the Fuel Society of Japan.
J. Geol.	Journal of Geology.
J. Inst. Fuel	Journal of the Institute of Fuel.
J. Instn auto. Engrs	Journal of the Institution of Automobile Engineers.
J. Inst. Petrol.	Journal of the Institution of Petroleum Technologists.
J. org. Chem.	Journal of Organic Chemistry.
J. phys. Chem.	Journal of Physical Chemistry.
J. R. aero. Soc.	Journal of the Royal Aeronautical Society.
J. Soc. aut. Engrs	Journal of the Society of Automotive Engineers.
J. Soc. chem. Ind.	Journal of the Society of Chemical Industry.
Khim. Tverd. Topliva	Khimiya Tverdovo Topliva.
Kop. Naft. Polsce	Kopalnictwo Naftowe w Polsce.
Matières grasses	Matières Grasses.
Min. & Metall.	Mining and Metallurgy.
Min. Mag. (Lond.)	Mining Magazine (London).
Monit. Pétr. roum.	Moniteur du Pétrole Roumain.
Montan. Rdsch.	Montanistische Rundschau.
Nat. Petrol. News	National Petroleum News.
Nature	Nature.
Neft. Khoz.	Neftyanoe Khozyaistvo.
Nickel Ind.	Nickel Industry.
Nov. Neft.	Novosti Neftepererabotki.
Nov. Tekhn. Bur.	Novosti Tekhniki Bureniya.
Nov. Tekhn. Neft.	Novosti Tekhniki Neftedobvicki.
Oel u. Kohle	Oel und Kohle vereinigt mit Erdoel und Teer.
Oil Gas J.	Oil and Gas Journal.
Oil Wkly	Oil Weekly.
Ole, Fette, Wachse	Ole, Fette, Wachse, Seife, Kosmetik.
Olii min.	Olii Minerali.
Paint Mnfr.	Paint Manufacture.
Paint Technol.	Paint Technology.
Petrol. Engr	Petroleum Engineer.
Petrol. Tech. (A.I.M.M.E.)	Petroleum Technology (American Institute of Mining and Metallurgical Engineers).
Petrol. Times	Petroleum Times.
Petrol. World (L.A.)	Petroleum World (Los Angeles).
Petrol. World (Lond.)	Petroleum World (London).
Petrol. Z.	Petroleum Zeitschrift.
Physics	Physics.
Pipe Line News	Pipe Line News.
Proc. Amer. Petrol. Inst.	Proceedings of the American Petroleum Institute.
Proc. Amer. Soc. Test. Mater.	Proceedings of the American Society for Testing Materials.
Proc. Ass. Asph. Pav. Technol.	Proceedings of the Association of Asphalt Paving Technologists.
Proc. Instn mech. Engrs	Proceedings of the Institution of Mechanical Engineers.
Proc. phys. Soc. (Lond.)	Proceedings of the Physical Society (London).
Proc. roy. Soc.	Proceedings of the Royal Society.
Przeg. Chem.	Przeglad Chemiczny.
Przem. Naft.	Przemysl Naftowy.

Abbreviated Title.	*Journal.*
Quart. J. geol. Soc. Lond.	Quarterly Journal of the Geological Society of London.
Rds & Rd Constr.	Roads and Road Construction.
Rec. Trav. chim. Pays-Bas	Receuil des Travaux Chimiques des Pays-Bas.
Refiner	Refiner and Natural Gasoline Manufacturer.
Rev. Comb. liq.	Revue des Combustibles Liquides.
Rev. Pétrolif.	La Revue Pétrolifère.
Rev. sci. Instrum.	Review of Scientific Instruments.
Riv. ital. Petrol.	La Rivista Italiana del Petroleo.
S. Afr. Min. (Engng) J.	South African Mining and Engineering Journal.
Strade	Strade.
Sulz. tech. Rev.	Sulzer Technical Review.
Summ. Ops, Calif. Oil Flds	Summary of Operations, Californian Oil Fields.
Tech. Phys. U.S.S.R.	Technical Physics of the U.S.S.R.
Tekn. Tidskr.	Teknisk Tidskrift.
Terr. Magn.	Terrestrial Magnetism.
Trans. Amer. geophys. Un.	Transactions of the American Geophysical Union.
Trans. Amer. Inst. Min. & Metall.	Transactions of the American Institute of Mining and Metallurgy.
Trans. Faraday Soc.	Transactions of the Faraday Society.
Trans. Inst. mar. Engrs	Transactions of the Institute of Marine Engineers.
Trans. Instn min. Engrs	Transactions of the Institution of Mining Engineers.
U.S. Bur. Mines, Inf. Circ.	United States Bureau of Mines, Information Circular.
U.S. Bur. Mines, Rep. Invest.	United States Bureau of Mines, Report of Investigations.
U.S. Bur. Mines, Tech. Paper	United States Bureau of Mines, Technical Paper.
U.S. Geol. Surv. Bull.	United States Geological Survey Bulletin.
U.S.P.	United States Patent.
World Petrol.	World Petroleum.
Z. dtsch. geol. Ges.	Zeitschrift der Deutschen Geologischen Gesellschaft.
Z. Geophys.	Zeitschrift für Geophysik.
Z. prakt. Geol.	Zeitschrift zur Praktische Geologie.
Z. ver. dtsch. Chem.	Zeitschrift Vereins deutscher Chemiker.

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Geology.

1. Origin of McMurray Oil Sands, Alberta. J. C. Sproule. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1133–1152.—The McMurray Oil Sand is the largest known deposit of its kind and the greatest potential petroleum reserve in North America. This paper outlines first the existing theories of origin, and then gives the author's own views as to the explanation of the genesis.

The McMurray formation is of Lower Cretaceous age, and overlies the Devonian and Silurian unconformably. In thickness it increases from east to west, being 90 ft. at Whitemud Rapids and nearly 200 ft. at McMurray. The chief feature of the formation is the variation, both vertically and laterally, in the sorting of grains. It consists mainly of coarse and fine sands and silts. In places cross-bedding occurs, but locally the deposit is evenly stratified or massive.

The principal theories of the origin of oil are outlined: viz., the *in situ* theory, clearwater shale theory—advanced from the dark marine shales overlying the McMurray, the residual theory, the lateral migration theory, and the origin from underlying Palæozoic rocks. This last theory (first suggested by Robert Bell) seems, from the evidence available, the more likely explanation. Bell considered that the oil seeped upward along cracks in the Palæozoic into the overlying porous McMurray Sands. The present author suggests, in support of this theory, that the oil entered the McMurray formation from the underlying Palæozoic somewhere between the Athabaska and Peace rivers, possibly midway between McMurray and Fort Vermillion.

G. S. S.

2. Regional Variations in Composition of Natural Gas in Appalachian Province. P. H. Price and A. J. W. Headlee. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1153–1183.—From a detailed study of the composition of natural gases in West Virginia it was shown that these have definite regional variations. This work is now thought to be suitable as a criterion for the entire Appalachian Province.

The variations are dealt with in relation to structure and sedimentation, as inferred by carbon ratios based on coal. The presence of various chemical compounds is shown for the Elk-Poca and Campbell Creek Oriskany sand-fields, Kanawha, and the Big Injun Sand. A series of diagrams also shows the distribution of the various components of the natural gases for these areas. G. S. S.

3. Refugio Oil- and Gas-field, Refugio County, Texas. P. F. Martyn. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1184–1216.—The Refugio field is situated in central Refugio County, Texas, approximately 165 miles south-west of Houston. The field was first discovered in 1919.

The surface exposures are tentatively classed as of Lissie age (Pleistocene), and consist of loose deposits of reddish sands and sandy clays. The oldest rocks penetrated by the deepest well (9225 ft.) have been those of the Vicksburg formation (Oligocene). Thicknesses of all the sediments ranging from the Lissie to the Vicksburg are given in tabular form.

During the various stratigraphic intervals recurrent structural uplifts took place, and production has shown that accumulation is not entirely dependent on the latest movements in the area, but is held occasionally in older folds which have been only slightly modified by later tectonic disturbances.

Production figures for the past years (1928–1937) show a total of 31,975,127 brls., that for 1937 being 1,850,274 and the peak year (1930) 11,224,512 brls.

A large number of structural and other maps accompany the paper. G. S. S.

4. Origin of Red Sea Depression. L. Owen. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1217–1223.—This paper reviews the various theories having reference to the origin of the Red Sea depression. The author refers to the fact that only a very small part of the Red Sea littoral is known geologically, particularly so in the case of the Hedjaz Coast.

Data so far collected confirm the suggestion postulated by Willis that the Gulf of Aqaba and the Red Sea are not only topographically distinct units, but that their origins are tectonically different. If it is accepted that the Gulf of Aqaba is a rift

or ramp fault feature, some other origin for the Red Sea depression must be sought. It is stated that no evidence of a conflicting nature has been noted as to whether the Gulf of Aqaba is either a rift or a ramp feature. Both rift and ramp conditions may have occurred during different stages of its history. G. S. S.

5. Geological Succession of Central Venezuela. M. K. Kaye. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1224–1230.—This is a short account of the geological succession of Central Venezuela, its object being to place on review the status of geological problems in this region.

The geology is dealt with under three structural aspects: the Coast Range complex, the Foothill zone or Coast Range, and the Post-Ortiz zones. These phases are briefly discussed in relationship to the main geosyncline, their problems outlined and recommendations made bearing on those problems. G. S. S.

6. Sediments of Great Salt Lake, Utah. A. J. Eardley. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1305–1411.—The investigation of the sedimentary environment of the Great Salt Lake was made from a study of its origin, chemistry, petrography, life and the topography and hydrography of the region draining into it.

The lake is a saline remnant of a fresh-water body, which, at its highest level, was 1000 ft. above that of to-day. A large number of analyses made of the sediments show that they all contain a large content of calcium and magnesium carbonates; at low levels sodium chloride (Halite) has crystallized on the lake bottom, individual "hopper" crystals being $\frac{1}{4}$–$1\frac{1}{2}$ in. across.

The sediments of Great Salt Lake may be classified as follows: the clays, oolites and the calcareous algae. All three are quite distinct and suitable for mapping; they are thought to have been derived from the same source materials. Through varying mechanical influences, however, on the activity of plant or animal life in the lake, they have each acquired different physical characteristics and quantitatively different chemical compositions.

Clays.—These are fine-grained plastic sediments, a property due chiefly to the base ions, particularly Na^+ attached to the clay particles. The average origin of the clays is approximately: clastic (including colloidal) material transported by lake currents 20%, material transported by wind 44%, material precipitated from solution 36%.

Mineralogically, the most common species present is quartz, with felspars, hornblende, biotite and tourmaline in varying quantities. (Other minerals were detected, but all in very small amounts.) The chemical precipitates—tabulated in percentages—are aragonite, dolomite, parasepiolite, absorbed bases, (Ca, Mg, Na, K) and (?) montmorillonite.

The average moisture content of the clays is 39% on a total weight basis. Compaction and dehydration apparently occur even at shallow depths. Interesting results are a crude hexagonal fissure system which occurs at two places, and the effects of a recent earthquake in liberating cold salt water in fissures around an almost buried bedrock hill. Bacteria seem to have been very active, because of sulphurous fumes emitted, but the diagenic effect on the carbonate and organic content, and this in turn on the colour, is unknown. The lake waters are probably reductive to iron compounds and prevent red colouring in the sediments.

Oolites.—The most favourable areas for oolite development are invariably along shore-lines which face the open lake and are exposed to vigorous wave action. The largest oolites occur on a bar off the south-west end of Antelope Island, which is washed by the open waves driven by the prevailing north-west winds. Ripple marks are well developed in the oolitic sands. The grains consist of nucleus and concentric layers about the nucleus. The nuclei consist of mineral particles (mainly quartz) and small pellets of the brine shrimp (*Artemia gracilis*). The concentric layers or bands consist of about 84% $CaCO_3$, 5·5% $2MgCO_3.CaCO_3$, and 5·6% of very fine clay.

The origin of the grains can be correlated with vigorous wave activity, particularly the oscillatory motion at the bottom and with the precipitation of calcium and magnesium on the lake floor; the two processes are believed to work together to build oolites. The carbonate is first precipitated as minute crystals near the surface owing to evaporation. These crystals sink, and on reaching the bottom are more soluble than the larger particles (the oolites already forming), and are redissolved. Simultaneously, molecules of carbonate come out of solution and build on the larger particles,

which are less soluble. Constant agitation by the waves causes the oolites to roll over and over, each time exposing fresh surfaces for accretion of carbonate molecules and removing any excess clay that might settle. Thus, layers of uniform thickness are built up. If it were not for the waves, a plastic carbonate clay would probably result.

Development of radial structure follows by inversion of aragonite to calcite with verging of the crystals until they are microscopically visible. The enmeshed clay is pushed either to the side of the growing radiate bundles of calcite, aragonite and dolomite crystals, forming dense white inter-ray regions, or to the lamination contacts. Inversion recrystallization and merging may continue to the extent whereby the complete oolite is radiate with only ghost lines of the former concentric layers.

Algal Bioherms.—The algae living in the lake have built extensive deposits of calcareous rocks. Their distribution, like that of the oolites, is limited chiefly to the western part of the lake. The bioherms range in depth from several inches to 10 or 12 ft., and consist principally of the deposits of the algal *Aphanothece Packardii*. The bioherms contain about 2% organic matter, 77% calcium and magnesium carbonate in the non-lamellar parts and 20% insoluble material. The CaO : MgO ratio is 11 : 1.

All lake samples examined, whether clays, oolites or bioherms, contained pellets. These are the rod-shaped fæcal pellets of the brine shrimp, *Artemia gracilis*, and are found in the eastern part of the lake as well as in the western, in deep water and in shallow. Making up nearly one-third of the lake sediments, they must be recognized as one of the most important constituents. Since the pellets contain 77% carbonate, and the bottom clays average only 47%, the shrimps, if bottom scavengers, must selectively ingest a proportionally large part of carbonate.

Following a description of the lateral sedimentary variations and burial of islands, the author concludes : if the lake clays become a source rock of petroleum in the future, as seems probable, the structure, the reservoir rock and the cap rock are apparently provided, and a set of conditions highly favourable for oil migration and accumulation will exist.

To facilitate reading of this rather long paper, a comprehensive summary of the properties and origin is given at the end of the description of each type of sediment.

G. S. S.

7. Darrow Salt Dome, Ascension Parish, Louisiana. C. E. Cook. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1412–1422.—The Darrow Salt Dome is situated on the east bank of the Mississippi River about 30 miles from Baton Rouge and 75 miles from New Orleans. It is also located very close to the eastern edge of the Gulf Coast salt-dome basin.

The dome itself is of the normal piecement type, the highest part being within 4627 ft. of the surface. A flattening is exhibited on the south shoulder of the dome, just below the 6000 ft. contour, but this is thought to be limited to the south flank of the structure. The maximum amount of cap rock is 61 ft., of which 37 ft. is limestone and the remaining 24 ft. anhydrite.

As with other domes of this type, much faulting, both radial and tangential, occurs on the flanks and probably over the top, due to tension and differential drag of the sediments.

Production has been obtained from super-cap sands and from flank sands representing the same horizon in the Lower Miocene. The most important production, however, has come from sands approximately 5700 ft. deep on the east and south-west flanks, and more recently from the south-east at a depth of approximately 7000 ft. The producing sands occur up against the salt mass at a relatively high angle. The oil sands thus cover a narrow horizontal area, making it very difficult to locate each well advantageously in the oil section. The deepest well drilled on the dome was on the south flank, but this was abandoned in Oligocene shales at 7980 ft.

On December 31, 1937, a daily production of 2074 brls. was obtained from eight wells, the dome having produced 1,518,921 brls. to the end of the year. G. S. S.

8. Cretaceous and Eocene Stratigraphy of Barrilla and Eastern Davis Mountains of Trans-Pecos, Texas. C. T. Jones. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1423–1439.—The Barilla and Eastern Davis Mountains are in parts of Reeves, Jeff Davis,

Pecos and Brewster counties, and flank the Toyah structural and topographic basin on the south-west. The rocks consist of Cretaceous sediments and Eocene volcanics.

The oldest of the Lower Cretaceous rocks (Comanche Series) is represented by a basal section of Trinity (?) and Fredericksburg age. Conformably overlapping this section is the Fredericksburg group (200 ft. thick), consisting of the Comanche Peak limestone at the base, the Edwards formation and the Kiamichi clay. Above this group occur rocks of Washita age made up of the Georgetown limestone and the Grayson clay and Buda limestone.

The Upper Cretaceous is represented by the Eagle Ford, Austin and Taylor formations, the basal Upper Cretaceous bed (Woodbine Sand) being absent in the area.

Of much interest is a major unconformity which occurs between the basal Taylor and the first volcanic rocks which are regarded of Eocene age. The unconformity zone varies in thickness from a clean-cut contact of lava and sediments, with a marmarized zone, to 60 ft. In this zone many facies occur—*e.g.*, grey clay underlying white tuff, and pebbles of Taylor and Austin limestone or marl under tuff.

The volcanics occur mainly in the form of lavas and tuffs. The lava-flows are very notable owing to the following facts: (1) each flow maintains its own common characteristics over the whole area; thus, in areas of disturbance, each flow can be recognized from hand-specimens, with one possible exception. (2) The flows are extensive over large areas, and may be traced farther north and south than east and west, indicating that they encroached over a very flat and gently inclined surface. (3) The flows thicken toward the west and south-west, but the thickening is very uniform and gradual. It is thought, therefore, that the source of these rocks lay in the Davis Mountain area west of Fort Davis. G. S. S.

9. The West Side of the Pompeckj Ridge in Cretaceous Times in Hanover. L. Riedel. *Z. Dtsch. geol. Ges.*, 1938, **90**, 26–41.—A question of importance is whether the discordances observed in the Cretaceous in various borings in Hanover are regional or local in origin. This problem is examined from the point of view of the variations in the shore-line of the "Niedersächsischen Becken" during the different stages of the lower Cretaceous. Present evidence points to the discordance being regional, and not due to local disturbances in the neighbourhood of salt-stocks. Conditions in Poland show a certain agreement with those in North-west Germany, and during the lower Cretaceous there was a bar, stretching from Hanover to Poland, which corresponds in position with the Pompeckj Ridge. S. E. C.

10. Petroleum and Natural Gas on the North Front of the Alps and Carpathians, with Special Reference to Tegernsee. A. Pilger. *Kali*, 1938, **2/4**, 1–7.—Petroleum and natural gas occur all along the northern front of the Alps and in decreasing quantities from east to west. Three tectonic units are oil-bearing: the foreland trough, the Flysch nappe and the Helvetian. Of these, the foreland trough is the most productive, and in this respect the younger sediments and the youngest tectonic movements are the most important. The petroleum geology of Roumania, Galicia and the Vienna Basin is summarized and the various occurrences, westwards to France, are mentioned. The Tegernsee occurrence is dealt with in more detail. Four tectonic units may be differentiated. The uppermost is the Upper East Alpine Nappe. Below this comes the Flysch nappe, which is thrust over the Helvetian. Finally the Molasse forms the fourth unit in the foreland. The oil has accumulated in the Helvetian Limestone, below the overthrust, although a very small amount of migration has taken place across the overthrust into the Flysch. The source of the oil is unknown. The Helvetian is not a true reservoir rock, accumulation having taken place in a disturbed zone. Search should therefore be made at Tegernsee for a reservoir rock which is properly covered. S. E. C.

11. Stratigraphical and Palaeogeographical Investigations on the Lower White Jura in Brunswick. W. Schott. *Jahrb. Preuss. Geol. Landesanstalt*, 1937, 697–729.—Schott's earlier work did not extend east of the line Hanover-Wietze. Since then further evidence has been obtained from deep borings in Brunswick, and this is incorporated in the present work, which deals with the Kimmeridge, Korallenoolith and Heersumer Beds. Six detailed sections are appended. S. E. C.

12. Progress of "D'Arcy Exploration." British Oil Search. Anon. *Petrol. Times*, 29.10.38, **40**, 565.—The Cousland No. 1 well near Dalkeith has been completed at a depth of 2917 ft. in such a condition that gas can be produced if necessary. There are five gas sands with a total potential production of over 10,000,000 c. ft./day of dry gas. In addition, a small show of excellent-quality oil was met between 1248 and 1275 ft. Cousland No. 2 is to be drilled 300 ft. down the flank of the structure on the crest of which lies Cousland No. 1, and a geological bore is to be made at Balfour near Kirkcaldy and due north of Cousland across the Firth of Forth.

The Hardstoft well has been cleaned and deepened from 3130 to 3272 ft. Its limestone reservoir rock is to be treated with solvent and acid. Further geological bores are to be put down in the Chaldon Down area, and on the basis of the geophysical work in and around Lincolnshire a deep well will probably be drilled between Lincoln and Nottingham. G. D. H.

13. Search for Oil in Tunisia. F. W. J. Saunders. *Petrol. Times*, 12.11.38, **40**, 644–645.—Search for oil in Tunisia began in 1908 with some very shallow wells in an outcropping oil-impregnated sandstone near Slougia. One well was later deepened to 380 ft., encountering heavily impregnated sand at 150–160 ft. In 1920 a well 350 yd. away found slight indications of oil at three points in a depth of 612 ft., but a third well found no oil in a depth of 900 ft. In 1922 several bores were made to depths of 150–170 ft., and 150 lit. of black asphaltic oil and salt water were obtained from the oil-impregnated sandstone.

A well in the plain of Medjerdah reached a depth of 2127 ft. without finding oil, but a 5755-ft. well on the Djebel Abderrahmane dome showed traces of bitumen, viscous oil, sulphurous gas and water at sixteen points, and finally encountered gas under a pressure of 25 atmos.

Since 1931 the oil search has been carried out by the State. Oil indications are found in beds ranging Trias to Miocene in age, and the best indications are at Ain Rhelal, Slougia, Fedj-el-Hadoum, Kef Bou Debbous and Djebel Kebir in North Tunisia; the domes of the Hadjeb-el-Aioun and Sbeitla regions of Central Tunisia; and the Berda zone of South Tunisia. The domes of North Tunisia resemble the salt domes of Texas and Louisiana. The Sahelian zone, although lacking in superficial oil indications, is viewed favourably on account of the presence of large closed domes. These will require testing to depths of 6000–7000 ft. G. D. H.

14. Effect of Angularity of Grain on Porosity and Permeability of Unconsolidated Sands. F. G. Tickell and W. N. Hiatt. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22** (9), 1272–1274.—Measurements of the porosity and permeability of single component separates from screen-sizing were made. The grains of these unconsolidated sands were somewhat equidimensional, and for each sample the "roundness number" (area of grain divided by its smallest circumscribing circle) was determined. On plotting porosity and a so-called "dimensionless permeability factor" against "roundness numbers," the porosity curve showed a minimum for a "roundness number" of 0·82 and the "permeability" curve showed a much sharper minimum at 0·75. The "dimensionless permeability factor" was the ratio obtained by dividing the permeability by the square of the average grain diameter. G. D. H.

Geophysics.

15. Problem of Secondary Tilt-Harker's Solution Corrected. E. M. Spieker. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22** (9), 1255–1260.—For most cases Harker's solution of the problem of secondary tilt is only approximate, and in some instances the error is notable. Harker's method is described and its defects are pointed out by means of a three-dimensional drawing. Additional operations are outlined whereby the method can be corrected to give an accurate result. The reverse problem of determining the resultant dip when an inclined plane is subjected to a second rotation can be worked out in a comparable fashion.

An alternative solution is provided in which the cotangents are used instead of the tangents. Although slightly more tedious than the previous method, it has the advantage of giving a better picture of the processes involved. G. D. H.

16. Problem of Two Tilts and the Stereographic Projection. D. J. Fisher. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22** (9), 1261–1271.—The general case of Harker's solution of the problem of two tilts is shown to be erroneous. The problem can be solved rapidly and accurately in terms of the normals to the bedding planes, by means of tracing paper laid over a meridional stereographic net. The Federow net can also be applied to solve the problem.

The meridional stereographic net is described and the method of working out the problem in terms of the bedding planes themselves is also given. Certain allied problems are amenable to solution by the use of the stereographic net. Thus the secondary tilt can be determined for faults, joints or cleavage surfaces, which may often be regarded as planes for short distances; also for lines or directions on these surfaces, such as slickensides, outcrops of beds or faults, elongation of minerals in cleavage surfaces, and flow lines in flow layers. G. D. H.

Drilling.

17. Intensive Drilling of Burma Fields Involves Unusual Problems. J. F. Dodge and W. A. Sawdon. *Petrol. Engr*, October, 1938, **10** (1), 65.—The principal oilfields of Burma are to be found on the Irrawaddy River, and extend for a distance of 40 or 50 miles. The development of the bed of this river is complicated by the necessity of maintaining navigability. The various fields of Burma are dealt with in some detail, the reservoir conditions, drilling and production methods being considered. L. V. W. C.

18. Importance of Properly Prepared Drilling Fluid Recognized by Operators in Burma. J. F. Dodge and W. A. Sawdon. *Petrol. Engr*, October, 1938, **10** (1), 76.—The mud used in the Yenangyuang and Singu Fields is made from a local shale. The shale is quarried, dried, crushed and ground. It absorbs some water, and is handled like cement.

The mud is mixed at the well in cone-type jet mixers, and for ordinary drilling a mud having a viscosity of 50–60 Digboi units is preferred. Where a weight in excess of 85 lb. is needed, barytes is used.

Routine tests are made hourly. At the pressure-drilling wells the tests made are: (*a*) viscosity by Digboi instrument, (*b*) weight, (*c*) sand content, by screening, drying and weighing, and (*d*) chloride salinity of mud. For ordinary wells a "mud-wate" indicator is used, and the mud is treated to maintain the viscosity at 50 or 60 D.U.

Chemical treatment is being used extensively. The three chemicals being used are: (1) sodium silicate, (2) cutch, a local tannin extract and (3) soda ash.

Settling is the general method available for removing cuttings and weight material is recovered by washing at the central plant. L. V. W. C.

19. Difficult Drilling Conditions Mark Development of Bahrein Field. K. C. Sclater. *Petrol. Engr*, October, 1938, **10** (1), 94.—The drilling conditions of the Bahrein field are peculiarly difficult. From the surface down to a depth approximately sea-level, boulders are encountered, and necessitate the setting of 200–300 feet of surface casing. Down to 1500 ft. is cavernous limestone, which in places contain pockets of tar.

The use of rotary has reduced the time required to drill through the limestone from 30 to 7 days, but all the difficulties have not yet been overcome. Circulation cannot be maintained, and drilling has to be carried on with caution; clear water is used as the drilling fluid. Extreme care must be exercised to prevent the drill pipe freezing should the slush pumps be shut down for any reason due to the fact that the cuttings are pumped back into the formation and settle quickly when there is no drilling water.

Rock bits are used entirely.

In the deeper wells circulation troubles are accentuated.

The temperature gradient is high—1 degree per 30 ft. of depth—the fluid temperature at 2200 ft. being 155° F. and at 4400 ft. 200° F. Slow-setting cement is necessary owing to the high temperatures.

Difficulties have arisen by mudding off the face of the pay sand, and to overcome this special muds that can be removed by acidizing are being tried.

An isobaric map is maintained to show the lines of pressure in the reservoir, and careful control is kept on the withdrawal of oil from the reservoir. L. V. W. C.

20. Excessive Pressure Complicates Drilling of Punjab Fields. J. F. Dodge and W. A. Sawdon. *Petrol. Engr*, October, 1938, **10** (1), 150.—All the production from Punjab Province comes from the Khaur field and the recently developed Dhulian field. The greatest amount of production from the Khaur field is obtained from the 3000 ft. sand, but several deep wells have been drilled. Snubbing equipment has been used in these operations, and, due to the pressures, it has been necessary to snub 5-in. drill pipe 2000–3000 ft. into and out of the hole at each round trip. A high-pressure water sand is generally found at a depth slightly below 5000 ft. Drilling is then carried on under pressure in a closed system, and when the 7-in. flush-joint casing is run, it must be snubbed in. The weight of the mud used averages about 74 lb. per cub. ft.

In the Dhulian field there are three or four fresh-water zones between 800 and 4200 ft. These zones sometimes flow 10,000–15,000 brl. per day at pressures ranging from 200 to 400 lb. per sq. in., thus causing considerable difficulty during drilling. When the zones are being drilled, the flow of water is so great that no attempt is made to use mud while rotating. After the bit has reached the bottom after a round trip, a few hundred brl. of mud are circulated to start, and when the tools are pulled, 400–500 brl. of mud are pumped into the well. The water flows are shut off by setting 11¾-in. casing, and the 90–94-lb. mud is used thereafter. L. V. W. C.

21. Modern Development Practice in Roumania's Deep Fields. K. C. Sclater. *Petrol. Engr*, October, 1938, **10** (1), 211.—Modern drilling methods are now used in the newer and deeper fields and the drilling practices employed by the important companies follow closely those of the U.S.A. Blow-out preventers, heavy mud pumps, control of drilling mud, and gun perforation of blank pipe are standard practices. The rate of drilling compares favourably with the best practice in the U.S.A., an example being 25 days for drilling and completing a 4000-ft. well. Tearing down, moving and rigging-up time average less than 14 days per well.

Close attention is paid to the selection of suitable equipment, drillers and drilling crews. A close control of drilling mud characteristics during drilling is practised, and evidence of this is the practice of maintaining the drilling mud at the proper viscosity, the use of vibratory screens, adequate settling arrangements and rapid circulation.

Economic steam generation is practised, and the driller has every important phase of the drilling operation under his constant observation by the provision of the necessary instruments.

Gas lift is in wide use as a production method. Paraffin deposition is combated by steaming of tubing, well-head connections and flow lines. Another method is to replace at regular intervals the top joints of tubing with clean joints. Hot oil is also used as well as chemicals. Mechanical scrapers are also employed.

L. V. W. C.

22. Bullets now Take Side Wall Cores. D. S. Sneigr. *Oil Wkly*, 26.9.38, **91** (3), 46.—The bullet side-wall coring device is an instrument designed to be lowered into a drill hole by means of the standard cable used for electrical surveys.

This device consists of a housing containing three or six bullets. Each bullet is fired separately by electrical means, using gunpowder as the propellant. The bullet is in the form of a cylinder, open at the outer end and closed at the rear. When fired, the bullet penetrates the formation to a considerable depth. During penetration the rear of the bullet is forced off, so that the first material gathered inside the bullet passes out, thus eliminating the mud cake of the wall.

The removal of the bullet from the hole is done by means of wires attached to the bullet and the housing.

The cores obtained are from ½ to ¾ in. in diameter and about 1¼ in. long.

L. V. W. C.

23. Derricks Moved Intact on Rollers to New Location. P. Flint. *Oil Wkly*, 26.9.38, **91** (3), 17.—Derrick skidding in California has been reduced to a routine operation. Two heavy duty crane-equipped trucks are used to lift the draw-works from the derrick floor and to place it on a trailer truck. The derrick is jacked up, prior to any moving operations, and is then pulled by a truck winch and a Y-shaped cable and block and tackle. The wooden trestle across the ground is kept at the proper elevation, and wooden rollers facilitate towing work. These rollers are moved forward as towing progresses. L. V. W. C.

24. Advanced Technique Employed in Developing Fields of Sumatra. J. F. Dodge and W. A. Sawdon. *Petrol. Engr*, October, 1938, **10** (1), 125.—Advanced technique employed in the Sumatra fields consists of electrical logging, formation testing and control of weight and viscosity of drilling fluid as standard practice. The various fields of the island are considered. L. V. W. C.

25. Numerous Wells are being Drilled in the Island of Borneo. J. F. Dodge and W. A. Sawdon. *Petrol. Engr*, October, 1938, **10** (1), 82.—The known fields of Borneo are being developed, deeper strata are being tested and all promising structures explored. L. V. W. C.

26. Drilling Patents. W. E. Winn. U.S.P. 2,134,808, 1.11.38. A well-surveying device using liquid to indicate the orientation of the device and a controllable compass.

G. C. Oliver. U.S.P. 2,134,886, 1.11.38. Core barrel.

J. C. Stokes. U.S.P. 2,134,988, 1.11.38. Core barrel.

J. C. Stokes. U.S.P. 2,135,737, 8.11.38. Core drill.

D. H. Smith. U.S.P. 2,136,596, 15.11.38. A well-drilling machine comprising a rig, a flexible-bit supporting cable, a pair of clamping members and springs connecting these members together to support the bit.

M. A. Lottinger. U.S.P. 2,136,748, 15.11.38. Means for positioning whipstocks in a well. L. V. W. C.

Production.

27. Gas Loading, Stage Treatment and Chemical Plugs Improve Gas Well Acidizing. O. W. Lyons. *Oil Wkly*, 12.9.38, **91** (1), 32.—The main difference between the acid treatment of an oil well and a gas well lies in the method and equipment used in treatment. Oil was not available at the first gas well considered for acidizing, and so water was used as the load to force the acid into the formation. This medium is still used to a certain extent. Practical and technical considerations have led, however, to the almost universal use of gas as the agent for properly directing the acid into the formation.

Where the area has a number of zones with low permeability and thinner zones with high permeability, it has been found that stage treatment offers more uniform increase in permeability than any other type.

It has been found that the success of gas well acidizing depends on the vertical distribution of the acid in the formation. Organic temporary chemical plugs have become very important. These plugs are solutions of organic material which enter the well-head in liquid form, but gel at the bottom of the well into gelatinous masses which have remarkable plugging properties. L. V. W. C.

28. Well Shooting Experiment may Develop Helpful Data. P. M. Phillipi. *Oil Wkly*, 12.9.38, **91** (1), 40.—Although a large number of wells are still shot, very little is known of the effect the nitroglycerine charge has on the sand body. Research has recently been carried out which may bring to light important data.

The object of the test was to shoot small charges of nitroglycerine in sandstone similar to the Bradford producing sand, and then expose the shot-holes for visual observation.

One of the principal points on which information was desired was the number and extent of the cracks opened up by the charge. Unfortunately so many cracks were formed in removing the face that it was impossible to judge how many resulted from the nitroglycerine itself.

The effect of the explosive shock appears to increase more than in proportion to the charge weight. Sand-tamped holes did noticeably more work on the sand than did water-tamped holes with an equal charge. L. V. W. C.

29. New East Texas Gas-Lift Plant Has Several Features. R. C. Smart. *Oil Weekly*, 19.9.38, **91** (2), 22.—A recent central gas-lift plant has several novel features. One is the repeated recycling of the gas used to lift the oil from the various wells without drawing on the residue lines. In addition to the necessary compressors, a large separator is provided in which the oil, gas and water produced from the wells are collected, the gas being separated from the liquid. This gas is scrubbed, and is then passed through a vacuum regulator and a 6-in. reducing regulator to the suction of the compressor. The pressure of the gas is raised from 5 to 350 lb. per sq. in., which is the normal operating pressure of the gas-lift system. Gas is removed from the oil and water, and is recycled in the gas-lift operation. Another interesting development is the reduction of high gas-oil ratios through the stream-lining of pipe arrangements. L. V. W. C.

30. Pumping Problems and Equipment in the East Texas Field. R. M. Bass. *Oil Weekly*, 17.10.38, **91** (6), 31.—There are but three major items to consider when putting the well on the pump. First, to be sure that the well is in a condition to pump—that is, to be sure that the fluid can get into the well by having the bottom of the hole clean. Second, select and instal properly the pumping equipment. This is governed by the particular location of the well. Third, to be sure that the sub-surface equipment, rods, tubing and pump are of the proper size and type to pump the volume and nature of fluid necessary. L. V. W. C.

31. Stage Separation of Crude Gas-Oil Mixtures. G. O. Kimmell and R. L. Huntington. *Oil Weekly*, 17.10.38, **91** (6), 40.—Original quantitative data are given on experimental laboratory runs covering the stage separation of a mixture of Oklahoma crude oil, butane and a dry natural gas. The relationship of the pressures between the successive separators gave the most interesting results. A constant stage pressure ratio of about 4·50 to 1 between each successive stage netted the lowest overall gas-oil ratio and the highest gravity crude oil.

Although the pressures studied in this investigation do not cover the retrograde region encountered in some "distillate" fields, it is believed that the results will throw some light on the technique to be applied in general to stage separation practice. L. V. W. C.

32. Influence of Oil Flow on the Water Content of Sands. N. Van Wingen. *Oil Weekly*, 10.10.38, **91** (5), 26.—Very little work has been done on the problem of the flow of oil through water-saturated sands. This problem involves a number of variables, each of which has a definite influence on the results. In analysing the problem it soon became apparent that there was no possibility of treating with thoroughness all the phases within a reasonable time. Only certain of the variables were considered for detailed study.

The flow system consisted essentially of a core-holder adapted to receive unconsolidated sand samples, and a pump, tubing and reservoir assembly arranged to maintain a flow of liquids through the core under any desired constant-liquid head.

Two liquids were used for displacing fluid: commercial water-white kerosine and ice-machine oil.

The results obtained show the relations between the specific permeability and residual water saturation, obtained by flowing kerosine and ice-machine oil under three different constant heads through a series of unconsolidated cores. A definite correlation between the dry core or specific permeability and the amount of interstitial water is indicated. The water saturation is greatest for cores of lowest specific

permeability, and the influence on permeability of water content is most pronounced where the specific permeability is lowest.

For the highest-permeability cores investigated it is of interest to note that for all three pressures the amount of remaining water is nearly the same. L. V. W. C.

33. Behaviour of Fluids in Oil Reservoirs. T. V. Moore. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22** (9), 1237–1249.—In order to obtain a good oil recovery, it appears that the pressure of the reservoir must be maintained at as high a value as is practicable, and the gas, oil and water must be kept as nearly as possible in their natural positional relationships. These conditions can be achieved by using low rates of flow, especially in fields under hydraulic control. Free gas and water should not be produced. Water and gas may enter a well by moving through parts of the sand containing little oil, or by moving with the oil. The former mode of entry can be checked by repair of the well, but little can be done about the latter. High rates of flow tend to bring about mixing of free gas and water with the oil, and may therefore lead to the premature development of high gas–oil or water–oil ratios.

The completion and repair of wells should be controlled by the nature and structure of the reservoir rock, as well as by the condition of the fluids therein. Variations in permeability of the rock are of special importance. More successful operations and a greater oil recovery will result if attention is paid to these points. G. D. H.

34. Analysis of Stresses in Hook-Offs for Wells Pumping By Central Powers. K. N. Mills. *Petrol. Engr.*, October 1938, **10** (1), 27.—In order to overcome some of the disadvantages of the common hook-offs as used for wells pumped by central powers, the notched slide-bar hook-off was designed. The most efficient position of the line of pull relative to the centre line of the notches in a slide bar was determined by a photo-elastic study.

A beam of polarized light was passed through a model of the part under examination, the model being made of an isotropic translucent substance such as celluloid.

Change of moment resulted in a change of colour band; the order of the bands from the centre when a beam was examined was yellow, orange, red, violet, blue, green, yellow, orange, etc. If a photograph is taken a series of parallel, equally spaced black and white lines results.

The colour and order of these bands have a definite relationship to the intensity of the shearing stress, and the coloured bands are loci of points of equal maximum shearing stress.

The points of stress concentration, and therefore points of possible failure, can be determined and by a process of trial and error eliminated or modified.

L. V. W. C.

35. The Geologist and the Well-Spacing Problem. E. Kraus. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1440–1446.—This paper briefly outlines the most recent and widely accepted engineering thought on well-spacing, and points out some of the salient corresponding interpretations.

The author quotes extracts from a summary report by the Special Study Committee on Well-Spacing (Amer. Petrol. Inst.), May 1938. This report is said to give the most enlightened engineering viewpoint.

A note of warning is given to the geologist concerning wide spacing. Spacing recommended for present producing conditions may be quite inadequate, if, owing to changed economic and other conditions, pools and wells which should be produced at restricted rates are changed to open rates. With such change for many kinds of reservoirs and accumulations, more wells will be required to fulfil the same degree of drainage that would have resulted with fewer wells under restricted flow.

G. S. S.

36. Systematic Operation of an Oil-Field. O. Lecca, *Monit. Pétr. roum.*, 1938, **39**, 1467–1472.—The article limits itself to oil sands which are the main source of Rumanian oil production.

Considerations due to sand porosity and permeability, oil viscosity and gas pressures, etc., are reviewed, and the logical conclusions reached on the type of

scheme under which oil-fields should be operated. Noteworthy among the suggestions is that any given field should be exploited either by one company only or that all the oil produced by any field should be apportioned among the companies operating in the field. T. C. G. T.

37. Production Patents. F. N. Osmun. U.S.P. 2,134,796, 1.11.38. Fluid-operated pipe cutter.

D. W. Hoferer. U.S.P. 2,135,076, 1.11.38. A well-pump having a movable barrel, a stationary plunger at one end and a movable plunger at the other. Slack connection is arranged between the barrel and the plunger so that the barrel may move with the movable plunger during a portion of each stroke and valves controlling fluid flow through the plungers.

W. J. Campbell. U.S.P. 2,135,167, 1.11.38. Swab.

S. A. Guiberson. U.S.P. 2,135,253, 1.11.38. Tubing catcher.

L. A. Layne. U.S.P. 2,135,583, 8.11.38. Combination packer.

S. E. Gray. U.S.P. 2,135,812, 8.11.38. Rigid coupling for sucker rods.

R. E. Fulkerson. U.S.P. 2,136,047, 8.11.38. Packing anchor.

J. Nixon. U.S.P. 2,136,518, 15.11.38. A pipe cutter adapted to cut by rotation, the speed controlled by the speed at which a fluid may pass from one of its chambers to another.

F. J. Spang. U.S.P. 2,136,597, 15.11.38. Well packer.

J. Johnson. U.S.P. 2,136,881, 15.11.38. A method of well washing in which a casing having perforations is installed in the well. Provision is made for transfer of liquid from a chamber in the casing to the casing adjacent to the perforations, for confining the liquid in the casing from upward or downward flow adjacent to the perforations, thus creating a sudden localized pressure in the transfer chamber and forcing the liquid outwardly.

C. F. Terrill. U.S.P. 2,137,104, 15.11.38. Fluid-flow indicator.

W. E. Lang. U.S.P. 2,137,167, 15.11.38. A method of controlling the recovery of oil from a sand having a number of associated productive strata of different permeabilities exposed in the same horizon, comprising selectively restricting the flow of oil into the well from the various strata commensurately with their respective permeabilities to minimize lack of uniformity in the oil depletion.

See also Abstracts Nos. 21 and 24. L. V. W. C.

Transport and Storage.

38. Patent on Storage. G. W. Johnson. E.P. 494,679, 28.10.38. Protection of internal surfaces of metallic reservoirs, pipes and other apparatus coming into contact with liquid fuels, by applying several coatings of cement, allowing these to harden in an atmosphere saturated with water vapour and then covering with a solution of magnesium fluosilicate. W. S. E. C.

Gas.

39. Research Aids New Laboratory Test Gas. W. R. Teller. *Amer. Gas Assoc. Monthly*, 1938, **20**, 298—302.—The performance of domestic appliances on liquefied petroleum gases was investigated. Appliances which demonstrate satisfactory performance on butane will give acceptable performance when operated on propane or butane–propane mixtures at the proper input rate, but no such assurance is had with appliances tested on propane. The amounts of air theoretically required for complete

combustion, as well as the theoretical products, are about the same for butane and propane on the basis of equal heat liberations, except that propane produces 5% more H_2O than butane. The inflammability limits of propane are higher and broader than those for butane. Propane can be burned at higher input rates than can butane without lifting or blowing of the flames. Propane and butane are similar in their tendency to produce yellow-tip conditions. The yellow-tip limit for natural gas is lower than that for either propane or butane. The primary air factors for propane and butane are 1·64 and 1·48, respectively, when a gas pressure of 11 in. of H_2O is used. Appliances approved for use with town's gas will be satisfactory for use on liquefied petroleum gases, provided modifications are made in the burner design and pilot arrangements. D. F. R.

40. Patents on Gas. N. V. Philips Gloelampenfabricken. E.P. 493,274, 5.10.38. Apparatus for measuring gas pressures.

Metallgesellschaft, A.-G., E.P. 493,818, 14.10.38. Production of concentrated SO_2.

U.S. Fire Protection Association. E.P. 494,754, 31.10.38. Method and apparatus for measuring electrically the thermal conductivity of gases.

H. T. Ringrose. E.P. 494,882, 2.11.38. Vapour-detection apparatus for detecting poisonous gases or vapours in the atmosphere. W. S. E. C.

Cracking.

41. Cracking Fuel Oil to Coke. K. M. Watson. *Nat. Petrol. News*, 2.11.38, **30** (44), R.524.—In order to meet changing market conditions considerable advances have been made in the design of cracking plant of exceptional flexibility. Such plants, operating on heavy residual fuel oil, may produce gasoline representing 70% of the charge and coke at the rate of 65 lb. per barrel of charge or a smaller proportion of gasoline, together with distillate furnace oil, gas oil and little or no coke. Cracking is usually carried out in a two-coil unit, to which the coking unit is added. The latter may, if necessary, be by-passed or used as a one-coil cracking unit. In running to produce only gasoline and coke, the cracking unit is operated to produce a residue of maximum viscosity, no distillate is removed as a side cut from the reaction column and maximum recycling is adopted on the coking chambers, which are maintained at maximum pressure. Three types of plant are described—namely, external-coking, integral-coking and pre-coking. Three methods are in use for the removal of the coke from the coking chambers: the cable method, in which a steel cable is placed in flat spirals in the chamber and withdrawn by means of a winch subsequently; or the rotary-drill method, in which the coke is drilled out; or the hydraulic method, by which removal is effected by high-pressure water-jets. Intensive marketing schemes are creating desirable markets for the coke. H. G.

Hydrogenation.

42. Patents on Hydrogenation. H. E. Potts. E.P. 493,470, 10.10.38. Improvement of fuel oils containing large quantities of hard asphalt by the addition of 0·1% of H_2 at pressures above 500 atm., and/or after the addition of cyclic hydrocarbon diluent—*e.g.*, middle oils, tetrahydronaphthalene, decahydronaphthalene or mixtures of these.

H. E. Potts. E.P. 493,947, 18.10.38. Catalytic destructive hydrogenation of carbonaceous substances in the liquid phase—*e.g.*, bituminous or brown coal.

H. E. Potts. E.P. 494,980, 4.11.38. Hydrogenation in the liquid phase of liquid carbonaceous substances containing less than 2% of asphalt to produce diesel fuel and lubricating oils. The process is carried out at 300° C. and at least 200 atm., using compounds of Mo and/or W as catalyst. W. S. E. C.

Polymerization.

43. Patents on Polymerization. Standard Oil Development Co. E.P. 493,726, 13.10.38. Polymerization of C_4 olefines in the liquid phase by means of acid, the initial polymer being separated into dimer and trimer fractions; the former are hydrogenated and the latter are depolymerized and repolymerized.

Distillers Co., Ltd., H. M. Stanley, and H. P. Staudinger. E.P. 494,575, 24.10.38. Polymerization of styrene and/or methyl styrene with an ester of crotonic or cinnamic acid in the presence of an inert medium—*e.g.*, *iso*propylbenzene.

H. E. Potts. E.P. 494,657, 28.10.38. Manufacture of lubricating oils by polymerizing or condensing with the aid of anhydrous aluminium chloride, liquid or solid unsaturated hydrocarbons or halogenation products of saturated or unsaturated liquid or solid hydrocarbons or their oxygen-containing derivatives in vessels constructed of chromium-coated iron, chromium, chromium-alloyed steels or chromium-nickel-alloyed steels.

W. W. Triggs. E.P. 494,752, 25.10.38. Polymerization of halogen butadienes.

W. W. Groves. E.P. 494,772, 1.11.38. Manufacture of polymerized products in an emulsified form by conducting the polymerization in the presence of water without the addition of an emulsifying agent and in the presence of a per-acid or of its salt.

N. V. De Bataafsche Petroleum Mij. E.P. 495,004, 4.11.38. Production of lubricating oil by polymerizing cracked distillates in the presence of aluminium chloride. If desired, the reaction products are neutralized (after removing the sludges), and/or treated with water and then heated in the presence of adsorptive earths at 200—300° C. in the presence of steam.

British Thomson Houston Co., Ltd. E.P. 495,072, 4.11.38. Method of making Co-Cr oxide catalyst.

Ruhrchemie, A.-G. E.P. 495,075, 4.11.38. Non-catalytic polymerization of gaseous olefines into liquid fuels at high temperatures and pressures in which, as the polymerization proceeds, the cross-sectional area of the gas flow is reduced.

W. S. E. C.

Refining and Refinery Plant.

44. New System of Combined Distillation or Fractionation. H. Priest. *Petrol. Times*, 19.11.38, **40** (1036), 669.—The essential feature of the new system lies in the recycling of at least a proportion of the residuum while temperature is controlled at the appropriate level. In this way the plant is always working at the optimum capacity, whilst the throughput can be varied infinitely between zero and a maximum depending on the size of the plant, without affecting turbulence. In starting the plant, the pipe-still and distillation column are connected in a closed circuit, and crude is admitted to a pre-determined level in the column. The oil is then recirculated until the temperature has reached the required level and the products from the distillation column are on specification. Crude preheated by exchange is then admitted to the residuum stream, and distillation products plus some residuum are removed in equal proportions. Plants have been operated at throughputs as low as 6 brls. per day by this means. Extreme flexibility, better fractionation and greater working economy are claimed. Owing to the fact that the charge is admitted at the bottom of the distillation column, corrosive components are said to be confined to that section of the unit, thus permitting the use of cheaper material in the pipe-still. Particularly good results are claimed when operating on coal-tar products. H. G.

45. Phenol Solvent-Extraction Process. R. Navarre. *Rev. Pétrolif.*, 22.7.38, (794/795), 933–937 and 29.7.38, (796), 971–973.—The various factors involved in the phenol solvent-extraction process are discussed with particular reference to the effects of temperature and water dilution. Improvement in the method of solvent treatment has a greater effect than variation in the properties of the solvent itself. Solvent

extraction is compared with fractional distillation, and it is found that one of the main causes for the low efficiency of the primitive isothermal counter-current solvent extraction (comparable to a bubble tower without reflux) is the decline in solubility towards the last stage of the treated oil in the solvent phase. It is concluded that, if the process is only governed by a temperature gradient, the latter would have to be very great, causing separation difficulties owing to initial high viscosities, whilst on the other hand, final temperatures may approach that of complete miscibility.

While for efficient solvent extraction complete separation of the phases is essential, the time of separation is governed by two factors : (1) the remoteness of the conditions of treatment from those of miscibility, and (2) the viscosity of the raffinate portion. As an example the isothermal solvent extraction of a Colombian distillate is discussed showing that a temperature gradient alone does not result in a sufficient gradient of solvent power. The problem is solved by progressive dilution of the solvent through water injection, resulting in a higher yield and a better utilization of the solvent power than with an invariable proportion of water in phenol. The method of treatment, comprising recycling and temperature and dilution gradient, is described, together with details of the tower contactor. The latter is highly efficient, possessing about fifteen times the treatment capacity of a bubble tower of equal size.

A naphthenic pseudo-raffinate can be separated from the primary extract by cooling or by addition of water. The yield of the solvent-extraction process is thus considerably increased by the separation of a valuable product of special characteristics and specific uses. In this case, as before, counter-current combined with dilution gradient help to improve both yield and quality of the naphthenic phase.

The remaining extract, consisting mainly of aromatic and unsaturated hydrocarbons, oxygen compounds and resins, has its special merits, showing that solvent extraction enables full advantage to be taken of all constituents of a given crude oil. Further improvements of the raffinate can be obtained by re-blending, and the benefits brought about by the paraffinic fraction and by a certain proportion of naphthenic fractions contained in an engine lubricating oil are enumerated and discussed.

The final section of the paper is concerned with specific problems of solvent extraction and chemical fractionation. Methods of dewaxing by solvents are discussed, and it is shown that the cold test can be improved without impairing the viscosity index. Resinous matter and asphalts which cannot be removed from residual oils by fractional distillation are most efficiently extracted by propane.

The third " active " fraction of the solvent treatment is also supposed to include the valuable natural oxidation inhibitors and the molecules which carry the property of oiliness. In conclusion, it is explained why present oxidation tests wrongly classify over-refined oils as being better than less refined ones of greater stability in service, and how over-refining can be avoided or remedied by the addition of synthetic inhibitors. L. R.

46. Removal of Paraffin Wax from Silicate Residuums. R. Fussteig. *Petrol. Times*, 26.11.38, **40** (1037), 703.—The article comprises a discussion of the mechanism of the absorption and adsorption of paraffin wax, resinous and asphaltic matter by the clays used for decolorizing, and a suggested method of the partial recovery of the paraffin wax. The used clay is extracted twice with gas oil at 95° C., the wax/gas oil solution being used a second time to extract fresh spent clay. The wax is recovered from the gas oil by crystallization and sweating. H. G.

47. Lubricating-Oil Purification. M. Varinois. *Matières Grasses*, **30** (364), 206–208, and **30** (365), 228–230.—Three main purification methods can be discriminated : the discontinuous, the continuous and the combined continuous and discontinuous. The main features of the three methods are described and their respective merits discussed.

Another section of the report deals with the various types of pressure filters in use, including fabric filters, various metallic filters (some of which have a capacity up to 3600 litres per minute), baked fuller's-earth filters, and " stream-line " filters. Details are given of design and operation, and the types of engines and machines for which the respective systems of filter are preferably used, are indicated. L. R.

48. Mercaptan Scrubber and Caustic Regeneration. Anon. *Refiner*, September 1938, **17** (9), 434.—H_2S is removed entirely and mercaptans are reduced by approximately 50% by scrubbing stabilized cracked gasoline with 24°Be NaOH. The NaOH solution is regenerated continuously by passing once through a 27 × 4-in. tower, chromium plated inside. The tower is equipped with a closed steam coil operating at boiler pressure, and exhaust steam is admitted through a spider in the solution in the base of the tower. Scrubbing with NaOH has reduced the plumbite required for sweetening by over 70%, whilst the lead susceptibility of the treated gasoline has been increased. H. G.

49. Mercaptan and Hydrogen Sulphide Removal by Caustic Scrubbing. J. C. Albright *Refiner*, September 1938, **17** (9), 437.—Pressure distillate containing 0·1% mercaptans, 0·22% total S and 0·002% H_2S is contacted, by circulation, with 14°Be NaOH in the cold for the removal of H_2S. The washed distillate is then passed to a two-stage washer containing 14°Be NaOH for mercaptan removal. In this washer the NaOH, after the first contact, is heated to 220° F. by closed steam coils to remove the dissolved mercaptans, cooled and contacted a second time with the distillate. All the H_2S is removed in the first washer, in which the NaOH is used until it is 75% spent. The two contacts in the second stage suffice to remove 50% of the mercaptans. Further sweetening may be carried out with "Doctor" solution. The process is almost completely automatic, and the consumption of NaOH in the mercaptan washer is negligible provided that H_2S is completely removed in the first washer. H. G.

50. Curious Case of Increase in Decolorizing Power of a Mixture of Two Decolorizing Earths. E. Erdheim. *Przem. Naft.*, 10.12.38, **23**, 634.—It was found that a mixture of two particular decolorizing earths had higher decolorizing properties than would normally be expected from a simple addition of their decolorizing powers. Tests were carried out on a mineral oil 9/10° E_{50} of Rumanian origin. The two earths "S" and "G" were of high and low quality respectively. The decolorizing effect with the above oil and 3% of the decolorizing earth was 87·1% in the case of "S" and 38·9% in the case of "G." From this it would be expected that 3% of a mixture of say 80 "S" and 20 "G" should have a decolorizing effect of $\left(\frac{87{\cdot}1 \times 80}{100}\right) \times \left(\frac{38{\cdot}9 \times 20}{100}\right) = 77{\cdot}5\%$. Actually, however, the result obtained was 81%.

A diagram is given in which the mixture composition (from 1–100 "S") is plotted against the decolorizing effect. The "theoretical" curve based on the principle of addition of the decolorizing powers is, of course, a straight line. The results actually obtained are all about 3½% higher, and also lie on a straight line. Similar results were obtained with other mineral oils, as well as with two vegetable oils. E. J. W.

Chemistry and Physics of Petroleum.

51. Limits of Inflammability of Gaseous Mixtures. P. Mondain-Monval and R. Wellard. *Ann. Off. Combust. liq.* 1937, **12** (6), 1183–1196.—In the case of the three mixtures studied, hexane–air, alcohol–air and ether–air, it is proved that under the triple influence of temperature, pressure and time of contact, the limits of inflammability differed considerably from the values usually determined either at ordinary temperature or under atmospheric pressure. The experimental conditions were such that pre-combustion was stimulated as much as possible. It appeared at temperatures characteristic for each mixture. For hexane–air mixtures, as has been previously established, there is a definite fall of pressure starting at 120° C., the fall continuing to 200° C., at which temperature there is a rise of pressure, accentuated as the temperature rises above 200° C. This rise of pressure is accompanied by the appearance of CO_2, alkyl peroxides, aldehydes, preceding the spontaneous combustion which occurs at 220–230° C. according to the concentration of hexane.

For ethyl alcohol–air mixtures heated under the same conditions the fall of pressure occurred below 190° C., the pressure rise towards 220° C. Finally spontaneous com-

bustion accompanied by aldehydes and CO_2 occurred between 250° C. and 265° C., according to the concentration of alcohol.

With ether–air mixtures the pressure fall starts at 110° C., continues to 165° C., followed by a very rapid pressure rise preceding by a little the spontaneous combustion at 170–175° C., according to the concentration of ether. Examination of the diagrams in the article shows that it is precisely at the temperatures which characterize in each case the beginning of the pressure rise and the appearance of the products of pre-combustion (200° C. hexane, 220° C. alcohol, 165° C. ether) that the curves representing the upper and lower limits of inflammability present a characteristic change of slope. It is considered certain that there is a relation of cause and effect between the two phenomena. At the lower temperatures the zone of inflammability is rather larger than at ordinary temperature under atmospheric pressure, for one quite obvious reason—namely, that the experimental temperatures are always lower than those at which chemical reaction between air and combustible liquid begins. J. L. T.

52. Aluminium Chloride in the Preparation of Aromatic Hydrocarbons from Paraffin Wax. C. Otin and M. Dima. *Monit. Pétr. roum.*, 1938, **39**, 1613–1620.—The authors have reacted a Roumanian paraffin wax with nascent $AlCl_3$. The wax had a m.p. 53·9° C., and a mol. wt. 354·7, indicating that it was largely $C_{25}H_{52}$. It was heated in the presence of aluminium and gaseous HCl introduced. Cracking, reduction, polymerization, isomerization and cyclization occur.

The yield of liquid products is better than that from the anhydrous $AlCl_3$ process. This fact is probably due to : (*a*) the greater activity of the nascent $AlCl_3$ and (*b*) the reducing power of the nascent hydrogen, released in the formation of the $AlCl_3$, which retards the polymerization of the unsaturated bodies.

Whereas the spirit fraction from the anhydrous $AlCl_3$ reaction contains only a trace of aromatic hydrocarbons, that from the nascent $AlCl_3$ method yielded 17% of aromatic hydrocarbons—largely benzene and toluene. T. C. G. T.

53. "Reactive" or "Protective" Colloids or Both. L. D. Betz and L. M. Potts. *Nat. Petrol. News*, 21.9.38, **30** (38), R. 470.—The article comprises a discussion of the paper entitled "Some Properties of Colloids and their Use in Water Treatment," L. D. Betz, *Nat. Petrol. News*, 15.12.37, **29** (50), R. 386. L. M. Potts objects to the differentiation of colloids under the headings "Reactive" and "Protective," claiming that the so-called "Protective" colloid is a "Reactive" colloid with certain special properties—*e.g.*, it can increase the stability of a colloidal system. He cites many references to support his contention. L. D. Betz, in replying, presents as many or more references to reinforce his own standpoint. By way of amplification, Betz defines a reactive colloid as one which is precipitated by an electrolyte, in contradistinction to those "protective" colloids, such as the tannins, starches and gums, which are not. H. G.

Analysis and Testing.

54. Determination of Total Sulphur in Benzol, Petrol and Other Liquid Fuels. F. Hurdelbrink. *Chem.-Z.*, 1938, **62**, 679–681.—The fuel is placed in a flask having two side-tubes fused through the neck, one of which reaches nearly to the bottom, so that air blown through it is carburetted, whilst the other is directed upwards, and supplies secondary air. The mixture is led to a burner head with Cu-gauze diaphragm, and the combustion products are absorbed in H_2O_2 in the usual way and titrated. 5–10 c.c. of benzol can be burned in 10–12 min. The distribution of sulphur in successive fractions of a crude benzol is tabulated. D. F. R.

55. Rapid Methods for Determining Oil in Greases. C. J. Boner, L. W. Yagle and G. A. Williams. *Nat. Petrol. News*, 19.10.38, **30** (42), R. 498.—Qualitative methods for the separation of the constituent oil in lubricating greases are presented. All depend on the separation of the oil phase by syneresis, decomposition or solution. For lime greases 500–1000 gm. of grease are mixed with 1% of hydrated lime, heated in an open vessel to 300° F. and stirred until syneresis is evident. The mass is then allowed to cool, when further working will cause the separation of sufficient oil to suffice for the need of the usual specification tests.

Clarification of the oil, from flecks of soap, by filtration through cloth or by centrifuging, is advisable before testing. For sodium grease, successive treatment with excess of boiling water is said to effect the complete removal of the soap leaving the oil, which, after a final extraction with dilute alcohol and heating to 212° F. to remove moisture, can be tested. Aluminium greases are first decomposed by boiling with 20–25% of 35–40°Be NaOH solution and then treated as a soda grease. Fillers, which may be present in the greases, are stated to be removed with the soap in every case. The methods are said to yield results strictly comparable with those obtained by the A.S.T.M. method, but they are not applicable to rosin base greases or to those containing E.P. dopes. H. G.

56. Flow Studies of Solid Fats. M. Aubert and A. Pignot. *Ann. Off. Combust. liq.* 1937, **12** (6), 1173–1182.—The flow caracteristics of lard were studied under the following experimental conditions. A metal tube, straight and polished on the inside, is first washed with benzene and toluene at 70° C., then with alcohol and ether, and finally dried with air. The lard is melted and poured into the tube through a funnel screwed into the top, a cock at the bottom being closed. The cock is then opened to expel the air, any air bubbles adhering to the sides of the tube being removed by gently stirring with a platinum wire. During filling the tube is surrounded by water at 70–80° C. Water at normal temperature is then run in slowly, the upper part of the tube being gently heated to ensure complete filling. The water-bath is then emptied and filled with ice and allowed to stand for 1½–2 hr. The lard is then levelled off at the top and bottom of the tube, which is connected up to a cylinder of nitrogen and pressure applied via controlling valves. The cock at the bottom of the tube being open, the movement of lard from the end of the tube is observed and the pressure at which motion seen through a telescope occurs inside 30 sec. is noted on a manometer.

At a temperature of 0° C. two sets of readings of pressure, P_1 and P_2, P_2 being the higher, are noted. They occur in no regular order, and show a value for P_2/P_1 of the order of $\frac{1}{10^4}$. It is considered that the existence of two types of lard called α and β is proved. It is, however, impossible to determine the conditions of formation of either type.

The effect of length and diameter of the tube was investigated. In tubes of 3 and 5 mm. diameter the α form occurs twice as often as the β form. In tubes of 6, 7 and 10 mm. diameter the occurrence of the two forms is practically equal, whilst in tubes of 4 and 9 mm. diameter the α form occurs more frequently. As regards the effect of the length of the tube, it was found that the pressure observed was directly proportional to the length of the tube. J. L. T.

57. Absorption Efficiency of Spiral Gas-Lift Wash Bottle. B. B. Corson. *Industr. Engng Chem. Anal.*, 1938, **10** (11), 646.—A spiral gas-lift wash-bottle is described, in which the length of contact between gas and liquid is greatly increased, compared with that obtaining in the Drechsel type bottle, without any corresponding increase in back pressure. Comparative efficiency tests, in which nitrogen–carbon dioxide mixtures were absorbed in solutions of caustic, showed the spiral type to be considerably more efficient than the Drechsel (99·9% CO_2 absorbed compared with 87·5%). T. T. D.

58. Small Low-Temperature Rectifying Column. J. H. Simons. *Industr. Engng Chem. Anal.*, 1938, **10** (11), 648.—A detailed description is given of a small still, with a capacity of about 5 c.c. of liquefied gas, which fits into a quart vacuum flask, and consequently is easily portable. The only additional apparatus required for operation is a source of electric current for the heater, a potentiometer for temperature measurement and a water pump. The device is a total condensation column and operates at constant pressure; it has been used successfully with liquids boiling at − 130° − 80° and − 50° C. T. T. D.

59. Patents on Analysis. Kodak, Ltd. E.P. 493,948, 18.10.38. Improved method of high vacuum distillation of organic liquids by adding to the distilland one or more carrier liquids. W. S. E. C.

Motor Fuels.

60. Calculation of the Octane Number of Gasoline from Physical Data. V. Schneider and G. W. Stanton. *Refiner*, Oct., 1938, **17** (10), 509.—A method for calculating octane numbers from such data as specific gravity, distillation characteristics and composition is presented. If the composition of a gasoline is known, then its octane number results from a calculation based on the proportion of each constituent and the blending octane number of the constituent. In developing the calculation presented, the data of Lovell, Campbell and Boyd, which were in terms of aniline points, were converted into octane numbers by the following equation. Blending octane number $= \frac{1000 \times \text{Aniline Number} \times \text{Sp. Gr.}}{2 \text{ mol. wt.}} + 55$. The octane number of each type of hydrocarbon was then plotted separately against its boiling point. Typical gasolines were then analysed, by the method of Schneider, Watkins and Stanton, and the results correlated with distillation data. Finally corrections necessitated by variations in unsaturateds were calculated on the basis of specific gravity and estimations of unsaturateds contents by the bromide–bromate method. The final results are presented in the form of three graphs to which the A.P.I. gravity or specific gravity and the distillation curve may be referred, to obtain, by means of a further simple arithmetical calculation, the octane number of the sample. A list of some forty calculated results is tabulated against the results of A.S.T.M. C.F.R. determinations. With a few exceptions the calculated results are within three points of the determined result.

H. G.

61. Stability of Alcohol Fuels towards Cold and Water. R. Heinze, M. Marder and G. Elsner. *Z. angew. Chem.*, 1938, **51**, 524–526.—Data for the clouding temperature of various ethyl and methyl alcohol petroleum spirit mixtures containing H_2O have been obtained, and are presented in the form of triangular diagrams. D. F. R.

62. Fuel Alcohol. K. Kurono. *J. Fuel Soc. Japan*, August 1938, 70–72.—Based on the law providing for a gradual increase in the proportion of alcohol admixture to gasoline within the next six years, the expected yearly alcohol demands are estimated. The possibilities of alcohol production from potatoes are discussed, and a comparison is given of the cost of production with each of the three methods of treatment available—viz. the rice-malt, the amylo and the acid-saccharification method. The amylo process is the most economical, and it is also used at present in the five Government plants in operation. L. R.

63. "Liquefied Gas." G. Gerson. *Auto. Engr*, 1938, **28**, 355–359.—This article is a survey of present practice in Germany in the use of liquefied gas as automobile fuel. About 15,000 trucks, omnibuses and tractors have been fitted with this type of equipment in recent years, and large tax reductions varying from 50 to 75% for such vehicles make its use an attractive proposition, especially as results show reduced running costs in comparison with petrol and diesel fuel. Vast supplies of suitable gases are available in Germany, and are manufactured in plants producing synthetic petrol.

Particulars are given of the general layout of the vehicle equipped for running on liquefied gases, together with details of the various items of special apparatus required, such as storage bottles, reducing valves and special carburettors. In practice the gas is carried in liquefied form in bottles under its own vapour pressure, which is from 75 to 150 lb. per sq. in. In order to regulate the gas–air mixture in the proportion required by the engine under the varying conditions of operation, the gas is expanded and vaporized in a single-phase or two-phase regulator. This regulator has to maintain a substantially constant pressure difference between the vapour pressure, which varies considerably under varying conditions, and the suction at the nozzle, and the function of the regulator can be compared to the constant level float of a carburettor. Requisite heat for expansion and vaporization must be applied to prevent the gas cooling to below the temperature of vaporization. The regulator must be sufficiently sensitive to open under the slightest engine suction, and when the engine is not running, the regulator valve must be completely gas-tight.

Details of fuel consumption on petrol/benzol mixture and liquefied gas show that 1 kilo. of gas is equal to 1·5 litres of liquid fuel. The cost of petrol in Germany is approximately 0·4 RM. per litre and that of liquefied gas is 0·5 RM. per kilo. An average figure for conversion of a 3-ton truck to gas operation is given as 400 RM.
C. H. S.

64. Patents on Motor Spirit. N. V. De Bataafsche Petroleum Mij. E.P. 494,450, 26.10.38. Removing mercaptans from motor spirit by means of an aqueous solution of caustic alkali containing 25–75% of glycol containing 3–5 C atoms in the mol. and ethanolamine as auxiliary agent.

N. V. De Bataafsche Petroleum Mij. E.P. 494,451, 26.10.38. Process as described in E.P. 494,450, using as auxiliary agent monoethyleneglycolmonomethyl ether.
W. S. E. C.

Gas, Diesel and Fuel Oils.

65. Ignition Characteristics of Diesel Fuels. R. Sundström. *Tekn. Tidskr.* (Automobil-och Motorteknik 10), 15.10.38, 76–79.—Comparison between various methods of expressing ignition quality, particularly aniline point, diesel index and cetane number. Attention is directed to the common habit in Sweden for diesel and semi-diesel engine manufacturers, as well as consumers, to pay a great deal of attention to properties of the fuel which have little bearing on ignition quality. R. F. S.

Lubricants and Lubrication.

66. Break-In Oils for Automobile Engines. K. T. Arter and R. Sundström. *Tekn. Tiskr.* (Automobil-och Motorteknik 9), 17.9.38, 65–68.—Discussion of requirements for break-in engine oils, based on recent theories of molecular forces and friction phenomena. R. F. S.

67. Patents on Lubricating Oil and Wax. G. W. Johnson. E.P. 493,557, 11.10.38. Production of lubricating oils by condensing halogenated paraffin wax with a small amount of isocyclic (1–5%) and a larger amount of cyclic (5–20%), hydrocarbons containing one or two rings.

A. P. Lowes and Imperial Chemical Industries, Ltd. E.P. 493,715, 12.10.38. Manufacture of oily condensation products from products obtained by condensing chlorinated aliphatic hydrocarbons of high mol. wt., in the presence of anhydrous aluminium chloride, and treating the reaction product with the hydroxide or anhydrous sulphate or phosphate of Fe, Cr, or Al, at 250–300° C., and separating the oil by decantation or filtration.

Deutsche Hydrierwerke. A.G. E.P. 493,766, 10.10.38. Manufacture of hard paraffin wax compositions containing one or more natural or artificial waxes and one or more alkaline metal or alkaline earth metal, Mg, Al, or Zn alcoholate derived from aliphatic, *cyclo*-aliphatic or fatty aromatic compounds containing alcoholic OH groups and at least six C atoms in the molecule.

Edeleanu Gesellschaft m.b.H. E.P. 493,999, 18.10.38. Improved method of recovering solvent mixtures used in refining or dewaxing hydrocarbon oils.

Standard Oil Development Co. E.P. 494,215, 21.10.38. Dewaxing of hydrocarbon oils using methyl normal propyl ketone. W. S. E. C.

See also Abstract No. 55.

Roads and Road Materials.

68. The Automobile and the Road. N. Gustafsson. *Tekn. Tidskr.* (Automobil- och Motorteknik 8), 20.8.38, 57–64.—Discussion of the effect of various properties of the road on fuel consumption, acceleration and top speed of modern cars. With regard to road surfaces, stone pavements and untreated roads, both of which are common in Sweden, are stated to be dangerous and permanent surfaces are considered essential. R. F. S.

69. Patents on Road Materials. D. Frunzetti. E.P. 494,380, 25.10.38. Manufacture of bituminous emulsions by mixing ordinary bitumen or tar emulsions with clay and cement under such conditions that the breaking of the emulsions or coagulation of the fine bitumen globules into coarser globules is prevented. W. S. E. C.

Special Products.

70. Patents on Special Products. I. G. Farbenindustrie., A.-G. E.P. 493,764, 10.10.38. Insecticide containing a diazoamine compound free from sulphonic acid and carboxyl groups, together with a solid inert substance and/or a wetting agent and/or an adhering agent.

Standard Oil Development Co. E.P. 494,859, 2.11.38. Preparation of detergent aids by reacting, together in one step unsaturated polymers produced from gaseous olefins, with phenols and conc. H_2SO_4, neutralizing the resultant products and separating the soaps therefrom. W. S. E. C.

Detonation and Engines.

71. Car Adjustment is a Large Factor in Anti-Knock Requirements. R. J. Greenshields, L. E. Hebl and T. B. Rendel. *Nat. Petrol. News*, 21.9.38, **30** (38), R. 464.—Sundry conclusions are presented as the result of an analysis of the data produced by the various co-operative tests which have been carried out in relation to the octane number of gasoline in recent years. The authors suggest that owing to the flexibility of spark advance mechanisms, the anti-knock requirements of standard cars is dependent on the octane number of the available motor fuels. By plotting the number of cars giving no knock at a particular octane number against the octane number and making separate curves for the results of the 1931, 1936 and 1937 tests, it is shown that anti-knock requirement has not changed appreciably since 1932, when fuels of a minimum octane number of 70 are considered. Fuels of lower octane value tend to be less satisfactory on the modern car than on its predecessors. Tendency to knock at full throttle is usually overcome by retarding the ignition, a device without sensible effect on the power output at high speed, but having an increasing effect as the speed level falls. From this fact it is argued that the habit of determining octane numbers at full throttle is not in keeping with the practical significance of the resulting figures. H. G.

72. Reduction of Piston-Ring and Cylinder Wear. M. O. Teetor. *J. Soc. aut. Engrs*, 1938, **42**, 137–140 and 156.—In spite of improved methods of manufacture, it is not yet possible to make a perfect cylinder or piston ring, and initial wear, commonly called the " wearing-in " process, compensates for mechanical and thermal distortion and improves performance. Engine performance rapidly reaches an optimum, and from then on the problem is one of wear reduction. The author discusses abrasive action in relation to surface structure, and describes a machine utilizing pieces of cylinders and rings for examining the wearing properties. Several problems arose during the experimental work, and the methods used to obtain operating conditions comparable with practice are described. The problem of " scuffing " was investigated, and curves are given showing the speed and load at which scuffing occurs with different types of ring and cylinder material. Results obtained with surfaces having a cellular surface known as " Ferrox " show this treatment to be very effective in the reduction of wear. C. H. S.

73. Supercharged Automobile Engines. N. Gustafsson. *Tekn. Tidskr.* (Automobil. och Motorteknik 6), 18.6.38, 44–48.—Description of work done to determine the effect of superchargers on ordinary cars. High-octane-number fuels and thin lubricating oils are required in order to reach top speeds with common models equipped with superchargers. The author concludes that superchargers will eventually become standard equipment not only in low-priced passenger cars, but also in trucks and buses. Acceleration and top speed, together with economy of operation and smooth running, are improved by the installation of a supercharger. The two latter are deemed exceedingly important in Sweden, where many roads are narrow and untreated and where, because of the snow, even the best roads are difficult to traffic during winter. R. F. S.

74. Characteristics of the Small Motor Car. R. Maeda. *J. Fuel Soc. Japan*, August 1938, 72, 73.—The characteristics of small motor cars, equipped with 750-c.c. four-stroke or 500-c.c. two-stroke engines, are discussed. The very low fuel-consumption figures of 74 m.p.g. average, and 120 m.p.g. optimum are claimed as having been obtained in a trial run of sixty-nine small cars of Datsun type. L. R.

75. Operating Characteristics for Hot-Bulb Engines. E. Hubendick. *Tekn. Tidskr.* (Automobil-och Motorteknik 10), 15.10.38, 73–76.—When plotting output against r.p.m. at constant fuel consumption on one and the same engine, curves of widely varying shapes were obtained. The failure to obtain smooth curves is attributed to some defect in the engine used (a two-stroke, hot-bulb engine delivering max. 10 h.p. at 1000 r.p.m.) or the arrangement of the exhaust line. Smooth curves could not be obtained by altering the latter, however, or by varying the injection. With normal engines and arrangements, such curves should have the shape of narrow ellipses with one end at the normal maximum point, in this case 10 h.p. at 1000 r.p.m., and the other approaching origin. The curve for minimum fuel consumption should be the narrowest, and those for increased consumption encircle the minimum curve, the ellipses becoming wider for higher consumption. If such curves could be obtained, they should be useful in selecting advantageous loads or to enable consumption to be obtained from h.p. and r.p.m. R. F. S.

76. The Skandia Hot-Bulb Engine. E. Hubendick. *Tekn. Tidskr.* (Mekanik 7), 16.7.38, 79–85.—Description of the Skandia hot-bulb engine, together with operating characteristics and tests. Fuel and lubricating oil systems and consumption are dealt with. R. F. S.

77. The Diesel as a High-Output Engine for Aircraft. E. G. Whitney and H. H. Foster. *J. Soc. aut. Engrs*, 1938, **42**, 161–168.—The development and success of the Junkers Jumo Diesel aircraft engine have been so outstanding in the face of rapid strides made by the gasoline engine that it cannot fail to attract the attention of the most sceptical regarding the merits of the Diesel engine for aviation. The present paper analyses results obtained at the N.A.C.A. laboratory and points out gains to be expected from the further development of the diesel engine for aircraft. Investigations have been made with both four-stroke and two-stroke single-cylinder engines, and the variables investigated have included combustion-chamber types both with and without forced air flow; fuel-injection systems; ground boosting; performance at altitude; factors affecting engine friction; effects of inlet air temperatures and pressures; and the effects of exhaust back pressure. Ten years work has resulted in an increase in I.M.E.P. from 100 lb. per sq. in. at 1500 r.p.m. to 260 lb. per sq. in. at 2500 r.p.m., and has produced everyday diesel engine operation at outputs equal to or in excess of those obtained on the best aircraft engines. Details of the results obtained from many of these experiments are given, and the principal conclusions reached are as follows :—

The four-stroke Diesel can, with maximum cylinder pressures not exceeding 1400 lb. per sq. in., provide take-off power equal to that obtained from gasoline engines using 100 octane fuel to best advantage, and at a lower specific fuel consumption.

The diesel engine offers the possibility of utilizing very high cylinder pressures to

the advantage of power and fuel economy, because the anti-knock value of the fuel does not limit its performance.

The use of after-coolers with the highly boosted diesel engine offers substantial increases in M.E.P. obtainable for a given specific fuel consumption.

The altitude performance of the diesel engine will be fully equal to that of the gasoline engine, although more stages in the blower may be required.

The two-stroke diesel offers the possibility of greater power per unit size and weight than a similar four-stroke diesel, at the expense of increased fuel consumption.

Successful development of the diesel engine requires research in improving combustion, improving materials and design technique to accommodate higher cylinder pressures, and improvement of blowers and after-coolers. C. H. S.

78. Combustion in C.I. Engines. M. de Sermoize. *Rev. Pétrolif.*, 18.11.38, (812), 1490.—The various factors involved in the combustion process are enumerated, and it is shown how difficulties can be overcome by the co-operation of engine designer and petroleum technologist. The characteristic fuel qualities for the various types of engines are mainly affected by speed, and the engines are therefore subdivided into high-speed engines, above 1500 r.p.m.; intermediate speed, up to 1000–1200 r.p.m.; low speed, up to 500–600 r.p.m.; and very low-speed engines with less than 200 r.p.m.

With some high-speed engines of the direct injection type, when operating on fuel above 65 cetene number, owing to a too short delay period, smoke is observed in the exhaust. Consequently, for engines above 1500 r.p.m., a cetene number below 70 is generally recommended, whilst a 65 cetene fuel should enable 4000 r.p.m. to be exceeded.

The 65% A.S.T.M. distillation point which indicates the volatility of light distillate diesel fuels gives no true indication with fuels containing residual oils. In this case the Conradson test is recommended for giving good correlation with practice. For large, slow-running engines a Conradson carbon residue up to 2, and sometimes 3% may be admitted. L. R.

Economics and Statistics.

79. The Fuel Industry. III Petroleum. H. Fahrion. *Die Energiewirtschaft der Welt*, p. 67–84.—This paper is based on the reports of various countries to the III World Power Conference in Washington. The figures in those reports have been revised according to the official figures published for 1936. A number of important producing countries did not furnish reports to the Conference, and details concerning such countries have been obtained elsewhere and included.

The petroleum industry may be divided into five sections—prospecting, production, transport, refining, use and commerce. Each of these is described in a few sentences. Particulars concerning the industry in Germany, France, Great Britain, Poland, Austria, Hungary, Roumania, Russia, Iraq, Iran, Dutch E. Indies, Canada, U.S.A., Mexico, Venezuela, Columbia and the Argentine are given. These show a continual rise since the crisis years, both in the production and use of petroleum products. A definite nationalist viewpoint is to be observed in the various policies of the different countries. S. E. C.

80. Petroleum Fuels in Relation to Agriculture in Great Britain. C. L. Gilbert, D. H. Meijnen and K. H. Sambrook. *Petrol. Times*, 8.10.38, **40** (1030).—Despite the progressive decline in the area of Great Britain under cultivation the consumption of Petroleum Products by the agricultural industry shows a steady increase. This is principally due to the steady growth in the use to mechanical aids to farming. The introduction of such new process as grass and hop drying and orchard heating are responsible for considerable increments in the consumption of fuel oil while the wider adoption of domestic and dairy devices consuming petroleum in some form indicates that petroleum will continue to satisfy a growing demand. H. G.

81. Agricultural Tractors in the U.S.S.R. in 1938. I. Ganitzki. *Monit. Pétr. roum.*, 1938, **39**, 1765–1766.—The U.S.S.R. tractor industry has been successfully developed

mainly due to the efforts of Americans, noteworthy among whom has been J. Calder. The tendency has been to increase H.P. from 15/30 to 30/40 and 48/60. The G.A.Z. organization has carried to a successful conclusion tests on producer-gas vehicles, and they plan to construct 5000 of these in 1939. The Tcheliabinsk factories, which have produced over 60,000 48/60 tractors, are now producing Diesel Caterpillars developing 75 h.p. They are also rapidly increasing their output of producer gas vehicles, and in fact they plan to produce 32,000 such vehicles in 1939, 10,000 being tractors.

The astounding growth in the mechanization of Russian agriculture is illustrated by the fact that in 1922 12,000 tractors were produced, and in 1937 the production had risen to 490,000.

The spare part service is only about 83% efficient, but the repairing facilities are good. An outstanding feature of the latter is the organization of over 6000 depots for agricultural tractors. T. C. G. T.

82. New Developments in the Russian Transport Industry. I. Ganitzki. *Monit. Pétr. roum.*, 1938, **39**, 1487–1489.—Rail traffic in the U.S.S.R. is developing steadily, thus trucks loaded in May 1938 numbered 96,626 per day against 95,515 in May, 1937. The speed of passenger trains does not compare at all favourably with English and American standards, nor does the rolling-stock and the tracks. There is a general drive to improve these conditions, and a locomotive developing a speed of 180 km.p.h. is under construction.

Civil aviation is developing rapidly, thus in 1938 it is expected that passengers will number 220,000, mail 7000 tonnes, and freight 38,000 tonnes. The most well-known aircraft is the A.N.T., after its constructor A. N. Tupolev. The Moscow–U.S.A. non-stop flight was accomplished in one of these machines. A plane constructed by Ilioutchine has flown 7600 km. at an average speed of 307 km.p.h. Russia, with 10,000 military planes, possesses about 25% of the world's military aircraft.

The most noteworthy development in road transport has been the encouragement given to the producer-gas vehicle. T. C. G. T.

83. Production and Operation of Automobiles in the U.S.S.R. I. Ganitzki. *Monit. Pétr. roum.*, 1938, **39**, 1633–1634.—The considerable progress that has been made in the construction of automobile factories is largely due to American firms. The Z.I.S. and G.A.Z. factories should, according to programme, produce 290,500 vehicles in 1938. The G.A.Z. organization, which has been considerably influenced by the Ford Company, is being reconstructed to produce 500,000 vehicles in 1940. The Z.I.S. concern is also being considerably extended.

The spare part industry is not progressing so well, and the facilities for repair are poor, though improving. T. C. G. T.

84. Development and Economics of Motor Propulsion. Anon. *Przem. Naft.*, 25.11.38, **22**, 621.—The paper discusses the shift in the proportion of coal to petroleum, as used for propulsion purposes, which has taken place in the last twenty-five years. This shift in favour of petroleum products is related to the development of the internal-combustion engine, particularly as used in mechanically propelled vehicles. An interesting table is given showing the respective consumption of energy per passenger and the respective consumption of fuel per passenger and 500 kilometres, for some of the most important means of communication.

By means of these figures it is demonstrated that the internal-combustion engine is most economical as far as small and middle size engines are concerned.

Some other considerations, such as the ratio of the weight to the efficiency of an engine, are discussed. E. J. W.

85. Oil in Hungary. Anon. *Przem. Naft.*, 25.11.38, **22**, 617.—The paper deals with the problems arising from the increase in oil production from the recently discovered oil- and gas-fields in Hungary. According to geologists, Hungary ought to attain complete selfsufficiency in petroleum products in not more than 1–2 years. The present output of 68,000 tonnes of crude oil annually—as compared with 495 tons in 1937—already covers approximately 1/4 of the internal demand. As it is probable

that this production will increase considerably, the Hungarian petroleum industry will be faced with the following main problems apart from these, which are purely technical :—

(1) Transport. The railway is somewhat inadequate in the south-eastern part of the country where the oil-fields are. Therefore there seems to be a possibility of an expensive pipe-line, 220 kilometres long, being laid.

(2) Refining. The question is whether the eight refineries the refining capacity of which amounts to almost 320,000 tons a year, will be able to cope with an increase in production. These refineries consist of distillation and refining plants only. It is said that the erection of a 4-million-pengö cracking plant with a capacity of 30,000 tons a year is being contemplated by the Government.

(3) The problem of alcohol addition to the petrol, which is now compulsory in Hungary, will have to be reconsidered. E. J. W.

86. Production of Liquid Fuels in Sweden. A. Billberg. *Tekn. Tidskr.* (Automobil- och Motorteknik 7), 16.7.38, 49–53.—A *résumé* of a preliminary report published by a committee appointed in 1937 by the Swedish Academy of Engineering Sciences. The committee concludes that with present prices of petroleum products it is uneconomical to produce synthetic fuels by any process known at present. Of the various processes available, hydrogenation of solid raw materials is considered the least suitable, partly because of the large investments and high costs. Hydrogenation of liquid tars of various origin seems to offer some promise. Of special interest is the production of tar by low-temperature distillation of peat briquettes. For experimental work in this direction Sw.Kr. 150·000 is requested. The newly erected plant at Perstorp, expected to commence operations shortly, will probably yield information and experience regarding production of liquid fuels by heating wood or sulphate rosin at high pressure in the presence of lime and hydrogen. The committee recommends no further action in this field until experience from this plant is available. Further work is recommended regarding the production of shale oil from Kinnekulle, the only important shale deposit in Sweden. The production of ethyl alcohol at sulphite works is considered to be Sweden's most potent asset in the field of liquid fuels, and attention is directed to the fact that the quantity of ethyl alcohol can be increased by suitably varying the conditions of the cooking process; there are also economic methods for producing ethyl alcohol from wood independently of cellulose production. Sw.Kr. 15·000 is requested for further work on such processes. Finally other substitutes, such as ether and acetone and their derivatives, are mentioned, Sw.Kr. 25·000 being requested to support research in that field.

The report contains a number of interesting calculations. The quantity of wood required to produce 100,000 tons of gasoline by the Bergius-I.G. process is given as 3,000,000 cubic metres, corresponding to 430,000 tons of cellulose, which is 19% of Sweden's annual cellulose production. According to this statement, a quantity of wood equivalent to that at present consumed by the entire cellulose industry would be necessary in order to produce Sweden's total gasoline requirements by the process just mentioned. R. F. S.

BOOK REVIEWS.

Practical Oil Geology. By Dorsey Hager. Pp. xix + 466. 5th Edition, 1938. McGraw-Hill Publishing Co., Ltd., London, W.C. 2. Price 24*s*.

This handbook is dedicated to the oilmen of America with the hope that it will bring to them a better understanding of geology and its importance to the oil industry.

The book deals with the origin and composition of petroleum, stratigraphy, palæontology and structural geology, with a chapter on prospecting and mapping, and also on the location of test wells. Drilling and production are allocated two chapters, followed by chapters on the occurrence and composition of waters, natural gas and oil shales. Geological field methods and geophysics are unsatisfactorily described, and finally a chapter is devoted to what the geologist has done for the industry. A collection of strangely selected tables forms an appendix.

The major complaint against the book is that it is slipshod and unscientific, and the reader is frequently irritated by statements of the obvious, such as, "Normally the older beds are beneath the younger. This simple law is the basis for determining the ages of beds. Folding and faulting, however, may change the positions of certain beds but not their age."

Descriptions lack conciseness and are frequently redundant, and, what is worse, are often interlarded with elementary calculations for which purely arbitrary figures are selected. For example, several pages are devoted to the sizes, shapes and packing of sand grains with mathematical calculations, only to be followed by, "Mathematical analysis of a true oil sand is senseless, unless all the grains are uniform in size and their packing is uniform, which is seldom the true condition. Experimental results on actual sands can alone provide the answer and the ranges of porosity secured from tabulated results." The meaning of the latter sentence is obscure, and sentences of this type are of frequent occurrence. On page 33 the following observation is made: "A heavy viscous oil will adhere to sand grains where a light oil will not; but this is questionable in deep wells, where the temperatures are high enough to raise the viscosity of even heavy oil so that they can flow from the rocks readily."

The more recent and most generally accepted theory of the formation of salt plugs is not mentioned, and the possibility of production from fissures and primary porosity of limestones is ignored.

The chapter on drilling is weak, and could well be brought up to date. The estimation of derrick height, with mathematical examples, from the number of panels which may or may not be 7 ft. high is elementary. No one will be able to grasp the operation of drill stem testing from the following description: "After drilling into an oil stratum, some idea of productivity may be gained by making a drill stem test. The device is run on the bottom of drill pipe. Opening a valve allows the fluid at the bottom of the hole to enter the pipe."

The book may have its uses to the practical oilmen of America, but as a source of information it is frequently unreliable and misleading, and seldom concise.

A. H. Tait.

Aktive Tonerde, Ihre Herstellung und Anwendung. By Dr. Ing. Franz Krczil. Pp. 274; diagrams 25; tables 29. Ferdinand Enke, Stuttgart. Price RM. 21·80 plus 25%.

This monograph on active alumina is the latest addition to the well-known series of technical chemical handbooks issued under the editorship of Professor Pummerer of Erlangen.

Like its predecessors, it is typical of its general class—that is to say, the author has selected a restricted subject and has by intensive study of the literature

(industrial, scientific and patent) collected together and neatly classified all available information on every possible aspect of this subject.

Such a compilation is of great value to the specialist, who tends to know more and more about less and less, and can with advantage be read in spare time by those who find themselves steadily knowing less and less about more and more.

The author has made a good choice of subject, for alumina is a material widely used for both industrial and for purely laboratory purposes, for both of which branches of scientific application its characteristic properties of adsorptive power make it of outstanding value.

The book is divided into three sections. The first deals with natural bauxite, with the variety of ways in which pure alumina can be made, and finally with the methods whereby aluminas with special physical and colloidal characteristics are prepared.

Part 2 deals with the physical and chemical properties of alumina, including especially its adsorptive powers for vapours, electrolytes, colouring matters and colloids.

Part 3, the largest and most important to the technical chemist, gives a full account of its industrial applications, which again are principally associated with its power for adsorption. Its uses in the purification of wet and vapour-laden gases, of drinking-water, of wine, sugar, oils and fats, mineral oil and waxes and physiological products are well described.

Another important industrial application—that of a filler in the paper, textile and rubber industries—is also dealt with, and finally a section deals with miscellaneous uses ranging from fluorescent screens to fireproofing and metal polishing.

The particular relation of alumina to the petroleum industry is slight, and occupies only a few pages of the book. All the published information relating to the use of bauxite for decolorizing and desulphurizing receives reference, but this refining agent is but little used to-day.

The general production of the book and its indexes is beyond criticism.

F. B. Thole.

Sea Transport and Measurement of Petroleum Products. By Capt. P. Jansen and H. Hyams. Pp. 185. T. L. Ainsley, Ltd., Mill Dam, South Shields. 1938. Price 12*s.* 6*d.*

This is a sound and workmanlike discussion of the subjects covered by the title. Clearly written, the book is useful not only to the junior ships' officers, to whom it is specially addressed, but also for general reference. The sections on oil measurement apply ashore as well as afloat.

The section dealing with transport opens with a description of the construction of tankers, including the more recent double-longitudinal-bulkhead type. Various arrangements of ships' lines and valves are illustrated in clear diagrams. Procedure at loading and discharge is explained, including ship-to-ship and ship-to-lighter transfers, with the safety precautions necessary then and during the gas-freeing of ships' tanks. The handling in bulk of asphalt, creosote, and animal and vegetable oils is outlined; packed petroleum cargoes are also discussed.

The section on oil measurement begins with a brief description of the principal classes of petroleum products and the laboratory tests commonly made on them; cargo sampling and the correct methods for taking specific gravities are discussed more fully. The differences between the various hydrometer scales in common use are fully explained, as is also the calculation of weights from their readings. Tables of coefficients for correcting both gravities and volumes for the effect of temperature are set out, with explanations and examples. Graphical methods of correction are also given, but by limiting their graphs to straight lines, the authors have lost the opportunity of allowing for the non-linear character of these corrections which is given when graphical methods are adopted.

Extensive tables facilitating the calculation of tonnages from 60° F./60° F. gravities and oil volumes in cubic feet are included, since many tankers still use cubic-footage tables. Metric tonnages are reckoned as weights in air from these tables; the fact is clearly stated in the text, but in practice metric cargo weights are more usually reckoned as *in vacuo*. The insertion in future editions of a table

allowing convenient conversion of oil weights in air to weights *in vacuo* would remedy this, which is the book's only notable omission. Other tables show the interrelation of units in the different systems of measurement, the figures given being those accepted in the Institute of Petroleum's own publication, "Measurement of Oil in Bulk"; weights per U.S. gallon, against both specific and A.P.I. gravities; pipe-line capacities for various diameters; interconversion of Fahrenheit and Centigrade temperatures; with other data more specifically nautical.

While legibility is not impaired, neither the printing nor the editing of the book is as good as it should be, considering the high standard of the text.

PETER KERR.

Veredlung der Crackbenzine. (Refining of Cracked Gasoline.) Pp. 73. Allgemeiner Industrie Verlag. Knorre & Co., K-9, Berlin, W. 9. Price RM. 6.80.

The particular difficulties encountered in the refining of cracked gasoline due to the high content of unsaturated hydrocarbons, some of which are beneficial, whilst others are harmful, are discussed. The chief methods employed to-day for refining cracked gasoline are then critically surveyed, grouped under the headings: (1) Chemical Methods, (2) Physical Methods and (3) Hydrogenation.

BOOKS AND PUBLICATIONS RECEIVED.

British Standard No. 21. Pipe Threads. Part I. Basic Sizes and Tolerances. Revised November 1938. Pp. 13. British Standards Institution, 28, Victoria Street, S.W. 1. Price 2*s*.

Oil in Mexico. By John Serocold. Pp. 72. Chapman and Hall Ltd., 11, Henrietta Street, London, W.C. 2. 1938. Price 2*s*. 6*d*.

The history and political motives leading up to the Mexican oil dispute, which resulted in the expropriation in March 1938 of the oil companies' properties, are clearly set forth. The implications and consequences of this policy, not only to Mexico and the British Empire, but to the world in general, are outlined.

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Geology.

87. Michigan's Allegan Boom. N. X. Lyons. *Oil Wkly*, 7.11.38, **91** (9), 42.—Allegan and Van Buren counties lie on the south-western edge of the Michigan Basin. The structures in this area do not always conform to the general north-west to south-east trends in the main basin, and several theories have been put forward to explain this anomaly, but so far none of them has been proved.

Three structural trends have been discovered, and it is suspected that cross-faulting is present. Production is from the Traverse Limestone, and the Salem, Monterey and Dorr fields all produce from this horizon. Accumulation has taken place in the upper part of the limestone just under the contact of the overlying Antrim Shale. The porosity of the reservoir rock varies greatly, and this factor influences production to a large extent. J. A. G.

88. Lease Play Gains Momentum as Deep Wildcats in Missouri Staff. D. Dalrymple. *Oil Gas J.*, 10.11.38, **37** (26), 18–19.—The area of North-East Missouri is one that may contain undiscovered oilfields. The regional geology is represented by the Nemo Uplift on the east and a similar but higher uplift on the west. Resting on the basement between these two features are a series of limestones, sandstones and shales which form an anticlinal arch trending east–west and dipping in a north-westerly direction. The Lincoln Fold which trends north-west from the Missouri River is considered to be of great importance. Around its southern end erosion has removed the younger rocks, but farther north the Mississippian is present, and below this series the St. Peters sand lies at depths ranging from 200 to 1300 ft. The total thickness of sediments varies from 2500 to 3000 ft. J. A. G.

89. Geology of Allegan County and the Surrounding District in South-Western Michigan. R. B. Newcombe. *Oil Gas J.*, 1.12.38, **37** (29), 32–34.—In this region the glacial drift covering the outcrops may be as much as 300 ft. thick. Pre-glacial erosion has usually removed the Marshall Series, and wells pass directly into the Coldwater Shales. About 400 ft. below the top of this series is the Coldwater Lime, which varies in thickness from 30 to 40 ft. Underlying this is the " red rock," consisting of an argillaceous limestone series, and this is used as one of the main marker horizons. Between the " red rock " and the Antrim Shales are the Ellsworth Shales. The base of the Antrim series may contain a bed of crystalline dolomite which overlies the Traverse Shale. It is from a dolomitic limestone 60 ft. below the top of the Traverse that production is obtained. In the Salem field a second zone of fossiliferous limestone has also given production. The Dundee Series is not always present, and the Traverse may rest directly on the Monroe formation.

The Salem and Dorr fields are located on the same north-west to south-east structure, and it is possible that further discoveries will be made on this structural line. Other pools are situated on similar sharp anticlines, the flanks of which dip steeply. There appear to be two distinct structural trend lines in the region, one north-east to south-west and the other north-west to south-east, and it is thought that the basement is faulted in a north-west to south-east direction and has influenced later deposition.

Away from the crests of the structures the porosity of the Traverse Limestone decreases rapidly. This is possibly due to solution effects during the time when the higher parts of the structures were close to the surface of the sea and formed shoals or islands. J. A. G.

90. Geologic Aspects of the Forest City Basin. W. G. Osborne. *Oil Gas J.*, 5.1.39, **37** (34), 12–13, 22.—Throughout the whole of this area there is a series of north-south anticlines and domes which may be due to crumpling in the soft Pennsylvanian series rather than to deep-seated folding. It is also possible that the surface structures may mask the more important folds of greater structural depth. The author points out that probably the most favourable structures for oil accumulation are those overlying folds in the original basement rocks.

The sedimentary cover varies from 3000 to 4000 ft. in thickness, and the principal oil horizons should be discovered below the Pennsylvanian.

On a map included in the paper the author has marked several zones of varying importance, and a brief discussion of their possibilities follows. J. A. G.

91. Economics and Geology of the Rocky Mountain Area. L. C. Uren. *World Petrol.*, August 1938, **9** (8), 34.—From a geological point of view the Rocky Mountain area includes part of Southern Alberta, but should not include South-East New Mexico. However, the author considers the latter district in the paper, and excludes the Alberta area because it is not in the United States.

Oil and gas accumulations are definitely related to the sedimentary basins which contain suitable structures. Nine of these basins are listed, and according to H. F. Davies, oil formation was contemporaneous with deposition, the oil remaining in the central parts of the basins until folding movements took place in late Cretaceous times.

Oil is found in rocks ranging in age from Carboniferous to Tertiary, including seven main horizons. The Muddy, Dakota and Lakota Sands series at the base of the Upper Cretaceous has proved to be the best producing horizon in the area. The Wall Creek Sandstone (Upper Cretaceous) is also an important producer, and is responsible for much of the production at Salt Creek, the biggest field in the region.

After a brief summary of the individual fields, the author points out that any estimate of reserves is necessarily very approximate, but in 1937 they were computed at 817 million brls.

The paper also includes a detailed summary of the refining, storage, transportation and marketing methods. J. A. G.

92. Progress in the Exploitation of Petroliferous Beds in Illinois. Anon. *Rev. Pétrolif.*, 18.11.38 (812), 1494.—Prior to 1936 the exploitation of oil in Illinois was not extensive. However, various discoveries were made in the southern part of this state, and the finding of deeper horizons, especially in the calcareous McClocky formation, in 1937 revealed the importance of these new fields. During 1938 the daily production has reached 100,000 brls., of which only 13,000 come from the old fields. In Illinois there has been more drilling in the past year than in Oklahoma or Kansas. Geophysical work has also been carried on actively. The fields are widely separated, and it is not unreasonable to suppose that the intervening area may hold good possibilities with regard to oil discovery. G. D. H.

93. Oil Search in Papua and New Guinea. Anon. *Petrol. Times*, 10.12.38, **40**, 765.—An exploratory borehole sunk to 1124 ft. showed traces of oil at several horizons, although there are no seepages within 7 ml. of the location. Strong gas-blows with a pressure of 400 lb./in.^{2} were also encountered. G. D. H.

94. Petroleum Prospects in Switzerland. J. Kopp. *Petrol. Times*, 3.12.38, **40**, 721.—There are many indications of oil in Switzerland. Traces of oil are found in the Subjura zone, near Dardagny in the Canton of Geneva; on the Talenbach, near Chavornay; near Orbe; near Murgenthal; and on the Gouhard, near Aarau. Asphalt impregnations are seen in fissures near Eclepeus, whilst a gas issue has long been active near Cuamay. The Val de Travers asphalt deposits have already yielded several million tons. In the Subalpine zone natural gas is found in the Ricken Tunnel, in the shafts of power-stations of the Waggital and of the Niederenbach at Engi, near Schwanden, as well as in the Rhineland, where recently gas was struck while drilling for water. Traces of oil have also been discovered on the Petersalp, on the Santis, in a well at Tuggen and in the Entlebuch. Oil and gas indications along the borders of the Swiss Alps continue into Bavaria and Austria, where in several places oil and gas accumulations have been exploited.

From his work on the Subjura zone Arm Heim concluded that the petroleum in the Oligocene Molasse is primary, but others disputed this, and Schardt traced the origin to deeper Triassic beds. As source-rocks of the Molasse oil the Meletta shales of the marine Rupelian seem likely. The Lower Tertiary supplies most of the Pechelbronn oil, whilst Rupelian beds contain important oil source-rocks in the areas bordering the Hungarian plains. However, there are evidences that the Rupelian was extensively eroded in the Subjura zone, but it may be present in the centre of the Swiss Molasse basin. No drilling has yet been undertaken on the favourable simple folds of the central area. G. D. H.

95. Petroleum and Natural Gas-Fields of Poland—Boryslaw : Geology. Vol. 2, Pt. 1. K. Tolwinski. *Service Géol. des Karpates*, Bull. 22, 1934.—Boryslaw is situated on the north border of the Carpathians. Two important elements are involved in its structure : the thrusted masses of the marginal Carpathians and the deep fold. The Miocene Salifère of the foreland extends for a considerable distance beneath these structures. The marginal thrusted masses are divided into two tectonic units : the "skiba" of Orow and the border "skiba." (Skiba = a Polish word meaning the ridge of earth turned up by the plough.) The border skiba is developed in the form of a recumbent fold, overturned to the north, and with a Cretaceous core. It disappears gradually to the south beneath the skiba of Orow, and only where it is so covered does it contain important deposits of petroleum. The skiba of Orow covers an extensive area between the border skiba and that of Skole. To the east and west of Boryslaw it becomes more and more intensely folded. The culmination of the structure lies in the Boryslaw–Orow zone, whilst the Schodnica and Urycz folds are on the south flank. Relatively shallow deposits of petroleum are found in Cretaceous beds in secondary folds within the area of culmination. The true identity of the deep fold was for long a matter of speculation, but intensive surface mapping and drilling have shown it to be yet another "skiba," and it may therefore be called the Boryslaw skiba. As with the other skibas, the general form is that of a recumbent fold. In addition to the folding on the south flank, the structure is cut by a series of transverse faults, striking mainly south-west to north-east, and these probably extend to considerable distances on both sides of the skiba. The undulations of the fold in the direction of the longitudinal axis, as well as the secondary folding, influence decisively the distribution of oil, gas and water.

The stratigraphy of the area is dealt with in some detail in a second chapter. All formations from the Cretaceous to the Oligocene are included, whilst, in addition, there are the saliferous clays of the foreland which are Miocene in age.

The third chapter traces the development of the theories concerning the geological structure of the Boryslaw area. S. E. C.

96. Petroleum and Natural Gas-Fields of Poland—Boryslaw : Petroleum, Natural Gas and Ozokerite Deposits. Vol 2, Pt. 2. K. Tolwinski. *Service Géol. des Karpates*, Bull. 22, 1937.—The surface area of the Boryslaw field is some 15 sq. km. With the exception of shallow production from the border skiba and the skiba of Orow, the greater part of the production comes from the Boryslaw skiba. The various productive horizons in that structure are, from upper to lower, the Polanica beds, the Menelite shales, the Boryslaw sandstone, the Upper and Lower Eocene and the Jamna sandstone. Each of these is described in some detail. The production statistics for 1886–1936 and the production history of each of the horizons are given in a second chapter and in an appendix.

The importance and the commercial value of natural gas were not realized for a long time, and consequently there was enormous wastage. The annual production of gas per well in 1936 was approximately only one-tenth of that for 1918. Efforts to collect and use the gas were first made on a large scale about 1910, in consequence of the disastrous fires caused by free discharge. The first attempts to recover gasoline by compression were made in 1913, and the first adsorption plant came into operation in 1922. The percentage of methane in the gas varies between 50% and 80%, and there are small traces of helium.

The oil-field waters are divisible into three groups, both on a basis of hydrostatic pressure and on chemical analysis. The first group comprises the waters in the border skiba and the skiba of Orow. The geological conditions in the zone are complicated and the number of wells in production relatively few, so that it is very difficult to interpret the data. In contrast, the characteristics displayed by the waters in the second group—Polanica beds and Salifère formation—are considerably more regular. A very marked aqueous zone in the Polanica beds surrounds the culmination of the Boryslaw fold. There is no constant water zone in the Salifère formation, but the waters which occur sporadically have a very similar chemical composition to those in the Polanica beds. The third group of waters is subdivided into those in the Boryslaw sandstone, those in the Upper and Lower Eocene, and those in the Jamna sandstone. On account of the similar hydrostatic pressures and chemical compositions it appears that the waters in these three sub-groups must be in communication.

The Boryslaw crudes are divided into four groups. The first three groups come from the border skiba and the skiba of Orow, whilst the fourth includes all the crudes from the various productive horizons in the Boryslaw skiba. The uniformity of the waters and the crudes from the Boryslaw skiba points to a common origin. Edgewater encroachment is taking place in all horizons and at a greater rate in the lower.

Ozokerite occurs in longitudinal and transverse veins in the Salifère formation. The filling of these veins is frequently fragments of the neighbouring rocks embedded in a mass of wax, which is often accompanied by rock-salt. The thickness of the veins is very variable, and in some instances they have a lenticular shape. The fractures which the ozokerite has filled—due to escape of crude and loss of volatiles therefrom—are the final stage in the structural development of the area.

Details are given of the deeper prospecting wells in the Boryslaw area and of the history of the field. S. E. C.

97. Kirkuk, a Field Developed with High Technical Skill. Anon. *World Petrol.*, July 1938, **9** (7), 58–63, 124–126.—The field of Kirkuk lies about 200 miles north of Baghdad, and is situated on a normal anticline trending north-west to south-east. Production is from the Main Limestone of Middle and Lower Eocene age, which is unconformably overlain by the Fars Series of marls, clays, anhydrites, etc. The structure developed in the reservoir rock is a flat-topped dome about 60 miles long and varies from 1 to 2 miles in width. The flanks dip up to 50°, and are sometimes affected by faulting. Located on the main fold are three domes: Baba Gurgur, Avanah and Khurmala. Production has been proved in the first two for a distance of 50 miles, but only gas has so far been found in Khurmala.

Numerous wells have been drilled, and most of them are producers, although some are used to give information regarding edge-water movement. Drilling has been carried on gradually, and the rock pressures can be easily calculated, thus making it possible to weight the drilling mud correctly. The porosity of the producing limestone is very good, and wells as far as 30 miles from the nearest point of oil removal are affected. It was decided to commence production by removing 30 million brls. per year from an area roughly 10 miles long by 2 miles wide. About 105 million brls. of oil have so far been produced, and it has not yet been found necessary to alter the scheme.

A short review of the pipe-line and terminal points is also included in the paper. J. A. G.

98. Natural Petroleums. C. Finaton. *Rev. Pétrolif.*, 16.12.38 (816), 1621–1624.—From 1859 onwards attempts to synthesize petroleum are numerous. Berthelot prepared acetylene, methane and ethylene. A few years later the organic theories of petroleum formation came into competition with inorganic theories, and in 1877 Radziszewski demonstrated the formation of CO_2 and a series of hydrocarbon compounds in the fermentation of cellulose. During the same year Berthelot and Mendeleieff investigated the action of water on metallic carbides. Eleven years later Engler's work on fish oils came to the fore. Sabatier and Senderens produced a whole series of hydrocarbons by catalytic hydrogenation, whilst in 1921–1922 Mailhe prepared a petroleum from vegetable oil.

The theories of Berthelot and Mendeleieff were taken up by some geologists, who accordingly proposed the existence of various substances deep in the earth, which on reacting with water would produce hydrocarbons; but various features associated with vulcanism refute these ideas. Hence geologists were drawn more and more to the organic theories. However, Engler and Mailhe required temperatures and materials (catalysts) which are not normal. Only the pressures are adequate, the temperatures calling for far too deep a burial.

The only reactions compatible with geological data are of the putrefactive types indicated by Radziszewski and Potonié. The natural laboratory of the sea has organic debris, aërobic and anaërobic bacteria, ionized compounds, catalysts of various types and prolonged time for reactions. The presence of optical activity in petroleums points to an organic origin. Recently œstrane, an animal product, has been found in petroleum. The occurrence of this unstable substance, which is only in small proportions in living matter, is remarkable. This hydrocarbon is also known in certain vegetables. The porphyrins, too, are found in natural bitumens and in almost all

petroleums (the oldest are without). Thus there is proof that petroleums have never been strongly heated. McConnell Sanders has observed all kinds of microscopic organic debris in petroleums. Hence their organic origin seems certain.

Fats are susceptible to hydrogenation, and bacteria can form hydrocarbons from cellulose. Methane and petroleum have been noted, amongst other things, in the mother liquors from the Stassfurt salts. The formation of paraffin hydrocarbons seems fairly straightforward, but the production of cyclic compounds presents more problems. Perhaps they were formed in areas of exceptional temperatures and pressures. In some of these areas geologists are said to have noted the lateral passage of carbonaceous to petroliferous beds, a fact which would be very significant.

G. D. H.

Drilling.

99. Humble Oil-Developing Means, Texas, Field in Orderly Manner. D. H. Stormont. *Oil Gas J.*, 10.11.38, **37** (26), 32.—The fact that the Means field, West Texas, is developed by one operator has enabled it to be worked in accordance with practices that make for the least amount of physical waste and result in the greatest ultimate recovery.

Only one drilling rig is being used. This is a steam-powered rig supplied by 3 125-h.p. boilers. The 122-ft. derrick is mounted on an 8-by-24-ft. steel substructure and the unitized draw works is driven by a 12-by-12 steam engine. Two pumps are used for mud fluid. Drill-pipe used is 4½ in.

No particular drilling problems are encountered, and in drilling the surface formations a rotating speed of 50–60 r.p.m. is used with the pump running slow and the weight on the bit varied, depending on the rate of penetration. When the salt and anhydrite sections are met, more weight is put on the bit, and the rotating speed is increased to about 125 r.p.m. In the lime sections the speed is again reduced to between 80 and 90 r.p.m., and the pump is run wide open.

As soon as the oil string is set, the 122-ft. derrick is skidded, a 94-ft. derrick is erected over the hole and the well is drilled in with a light portable rotary. By this means the drilling rig is kept in almost constant operation.

All wells are first tested naturally, after which they are acidized in either two or three stages.

Paraffin accumulation is the chief production problem. L. V. W. C.

100. Pure Oil Co. Uses Tapered Seats for Casing Illinois Wells. H. Simons. *Oil Gas J.*, 24.11.38, **37** (28), 56.—The Pure Oil Co. are successfully running casing in wells in the Illinois basin area without the use of cement behind the pipe. This is being accomplished by the use of a tapered seat for the casing, which makes the landing of the string possible.

The method as used calls for the making of a 3-ft. seat tapered from 8¾ to 6¼ in., in which the casing rests. The taper is formed by special drag-type reamers with hard facing on the cutting edges. The Rosi Clare lime in the top of the Ste. Genevieve is the formation selected for the casing landing-point.

The mud is conditioned, starting at 2500 ft., until by the time the casing point is reached it has a weight of 10·2 lb. per gal. and 40 viscosity. L. V. W. C.

101. Whipstocks are being Used in Deepening of California Field. T. P. Sanders. *Oil Gas J.*, 1.9.38, **37** (16), 30.—The most active locality in California is the 16-year-old Torrance field, where ninety wells have been completed during the past eight months in a newly discovered 4800-ft. sand.

Most wells in the Lomita area drifted to the north, which is up-dip, and for this reason directional drilling is often used in deepening, the object being to deflect the hole back to the south.

In the majority of deepening jobs all or part of the liner is side-tracked. Four different methods are used. A whipstock is being used for drilling out through the water string which obviates the use of cement as a base for the deflecting tool. After the whipstock is in place in the water string, a mill is used to drill the window.

It is necessary to use whipstocks frequently in directional drilling at Torrance, because the bit exhibits a strong tendency to remain vertical or to drift slightly north.

A dual-seal cementer is used to cement the upper stage. It consists of a 10-ft. joint of casing through which three holes have been drilled near the lower end. These holes are sealed with frangible phosphor-bronze discs which are dislodged by pressures greater than 2000 lb. A metal sleeve is welded around the joint, and at the top of the sleeve are ports closed during installation of the casing by thin strips of metal. A gun perforator is used to rupture the discs. Two cementing jobs can then be performed at the same time, and one shut-down period is thus saved. L. V. W. C.

102. Illinois Drilling Methods Reduce the Time Required on Well. H. Simms. *Oil Gas J.*, 15.9.38, **37** (18), 49.—The drilling campaign in the Southern Illinois basin requires rigs that can be rigged up with a minimum of time and expense, and yet be capable of drilling the hole in a few days, since the depth from which production is obtained does not exceed 3000 ft.

As a result most derricks are 96-ft. structures and some are even 85-ft. pumping derricks.

Generally the rigs are conveyed to the site on three trucks, exclusive of drill-pipe. Rigging up of rotary drilling tools requires only a short time.

Surface pipe is not set in many instances, and only thin mud is used after passing the 400-ft. mark, and as little mud as possible is used, owing to the cost of water.

L. V. W. C.

103. Difficulties of Killing Blow-Out in Coastal Louisiana Well. N. Williams. *Oil Gas J.*, 13.10.38, **37** (22), 44.—The Texas Co. No. 2 B State, in Vermillion Bay, off the coast of Iberia Parish, coastal Louisiana, was successfully killed, and this article is a *résumé* of the report prepared for the Louisiana Department of Conservation.

As the well was located in from 5 to 9 ft. of water 3 miles out in the bay, 16 miles by water from the base of operations and 27 miles from New Iberia, its blow-out and killing presented unusual problems. The well blew out on June 3rd from a depth of 9667 ft. while the $2\frac{7}{8}$-in. drill-pipe was being removed.

Two 10-in., 6000-lb. test control valves were used in the Christmas tree, and the whole tree was assembled and flanged on a blow-out truck and loaded on a barge, which was towed to the well. Electric welding after the Christmas-tree connections had been stabbed into place resulted in small fires around the swage, and welding had to be discontinued. Unfortunately the whole tree was blown into the bay, resulting in the deaths of two men. A new Christmas tree was assembled, and with water being pumped in continuously, the well was eventually killed on July 17th.

L. V. W. C.

104. Advantages Gained by Use of Welded Casing in Oil Wells. E. W. P. Smith and R. L. Looney. *Oil Gas J.*, 1.9.38, **37** (16), 34.—Information is given as a guide to the welding of oil-well casing. The procedures outlined in this article are based on the experience of the past three or four years in California and Mid-Continent fields. The advantages of using welded casing and various factors to be considered are dealt with. L. V. W. C.

105. New Rotary Drilling Equipment. Neubauer. *Oel u. Kohle*, 1938, **14**, 757.—An account of several patented systems for transmitting and reversing the drive from diesel engines to drilling equipment. P. G. H.

106. Characteristics, Methods of Combating and Economic Importance of Heaving Shales. Part 1. M. T. Halbouty and N. A. Kaldenbach. *Oil Wkly*, 24.10.38, **91** (7), 17.—This article deals with the geological and geographical distribution of heaving shales in the Texas–Louisiana Gulf Coast and their definition, classification and causes. A general outline has been adhered to in an attempt to present the many different phases of the heaving-shale problem. L. V. W. C.

107. Characteristics, Methods of Combating and Economic Importance of Heaving Shales. Part 2. M. T. Halbouty and N. A. Kaldenbach. *Oil Wkly*, 31.10.38, **91** (8), 42.—The mechanical practices in combating heaving shales are described, and recommendations are made for additional studies on this important subject.

L. V. W. C.

108. Viscosity Characteristics of Clays in Connection with Drilling Muds. G. Broughton and R. S. Hand. *Petrol. Tech.*, **1** (4), Nov. 1938, A.I.M.M.E. Tech. Pub. No. 1002.—The clay suspensions were examined in MacMichael- and modified Bingham-type viscometers. The form of the time–torque curves for different setting times points to two distinct mechanisms causing resistance to shear, and even to two types of gel structure. Torque–r.p.m. curves, using asymptotic values from torque–time curves, were substantially straight lines. Alcohol and pyridine caused marked rises in yield value without greatly affecting the mobility, probably due to flocculation. Heating a bentonite suspension in a sealed tube at 100° C. for a week raised both the yield value and the viscosity at infinite shear. Barium hydroxide, but not sodium hydroxide, produced thixotropy in a bentonite suspension, indicating that it is not p_H value alone which controls the viscous properties of muds. The viscosities of different size fractions of kaolin and ball clay were measured, the values being higher for the smaller sizes, which also show yield values.

Alcohol diminished the stability of clay suspensions, presumably by reducing solvation. There appears to be no consistent connection between yield value and thixotropy. In aqueous ball-clay suspensions, yield value rises with rise in temperature. G. D. H.

109. Mud Technique in Iran. M. W. Strong. *Petrol. Tech.*, **1** (4), Nov. 1938, A.I.M.M.E. Techn. Pub. No. 1005.—Graphical routine records of all mud operations are kept showing: (1) gravity recorded on rig; (2) gravity recorded in daily laboratory samples; (3) Marsh funnel viscosity; (4) mud losses to formation; (5) pump pressures, average and maximum; (6) pumping speeds in deep wells; (7) remarks on general drilling conditions, additions to mud such as bentonite, brine, barite, etc., shows, formation changes and the like; (8) size of hole, size and type of drill-pipe and casing; (9) salinity of the mud where necessary. These charts are not necessary for normal wells, but for deep wells, or when drilling in difficult formations, such logs are of considerable value. Rotary flush sampling has been so developed that excellent well logs are obtainable for little time and expense, without resorting to coring for other than dip evidence or special research specimens, even under complicated tectonic conditions.

The main problems are the use of very heavy muds to combat high-pressure shows, the formation of suitable filter cakes and the conquering of lost circulation. Routine laboratory work calls for the chemical and physical examination of all mud materials contemplated for use, whilst research includes the investigation of sedimentation and allied processes, viscometry, the examination of surface tension and of sealing mechanisms. The use of oil–water emulsions for low-gravity drilling fluids is being tested.

The loss of pressure in a mud column due to gas-cutting is calculated.

G. D. H.

110. Drilling Patents. J. H. Howard. U.S.P. 2,138,006, 29.11.38. Rotary core drill.

J. H. Howard and P. C. Efromson. U.S.P. 2,138,007, 29.11.38. Reaming cutter mounting.

C. B. Wright. U.S.P. 2,138,719, 29.11.38. Blow-out preventer.

D. S. Anthony. U.S.P. 2,138,897, 6.12.38. Reamer.

R. G. Gates. U.S.P. 2,139,075, 6.12.38. Suction bailer.

R. G. Gates. U.S.P. 2,139,076, 6.12.38. Method of recovering or moving pipe by applying a strain to the pipe and suddenly allowing liquid in the well to enter an air-chamber to create a vertical surging of the liquid column.

A. Gray. U.S.P. 2,139,077, 6.12.38. Method of making drilling jars.

H. I. Davis. U.S.P. 2,139,444, 6.12.38. Device for recording inclination of a well by means of a recording liquid.

O. C. Snell. U.S.P. 2,139,525 and 2,139,526, 6.12.38. Blow-out preventer.

L. V. W. C.

Production.

111. Sun Oil Co. Completes Well with 6300 lb. Pressure on Gulf Coast. N. Williams. *Oil Gas J.*, 10.11.38, **37** (26), 41.—The pressure registered on the gauge of the Sun Oil Co. No. 1 Bayshore Farms in the Palacios field, Texas Gulf Coast, was more than 6300 lb., and this is claimed as the greatest pressure ever encountered.

The use of effective high-pressure well-control equipment and the exercise of care and precaution alone made control of this well possible.

Flowing through a $\frac{7}{64}$-in. and a $\frac{1}{2}$-in. choke in an auxiliary flow manifold 80 ft. from the well, and with pressure stepped down through a $\frac{1}{2}$-in. choke at the well, the well is holding a working pressure of 5500 lb.

To facilitate the changing of chokes, the auxiliary flow manifold was provided.

The well blew out while the drill-pipe was being pulled and, out of control, it ignited. As the fire was about to be shot, a head of shale and mud from the well shut off the gas momentarily, snuffing out the blaze. The well was quickly capped and the flow-lines were connected up. L. V. W. C

112. Better Completions Reduce Gas–Oil Ratios in Goldsmith Field. D. H. Stormont. *Oil Gas J.*, 1.9.38, **37** (16), 45.—One of the most important recent developments in the Goldsmith field is the great strides made in reducing gas–oil ratios, brought about by more careful well-completion methods and the reworking of wells having too high a ratio.

The use of drilling time curves has become fairly widespread in this field, and many operators take advantage of the knowledge gained regarding a formation's characteristics to seat the casing point in a hard shell, if possible. Drilling time is also used to determine the total depths of wells, as well as to pick the point at which packers and liners should be installed to secure lower gas–oil ratios.

Much work has been done in perfecting the technique of acid treatment, and close studies are usually made of the reservoir formations before attempting to acidize. L. V. W. C.

113. Factors which Influence Pumping Unit Selection. E. Kemler. *Oil Gas J.*, 18.11.38, **37** (27), 110.—The author shows that gear units for pumping should be applied on the basis of peak torque, and the data and theory presented indicate that: (1) the engine-drive service factors are not correct, and result in excessive penalties to properly equipped single-cylinder engines; (2) torsional vibrations can be set up in gear drives, and must be given some consideration in future design; (3) the use of maximum load in figuring peak torque will give units larger than necessary if based on calculated loads at high speeds; and (4) further consideration should be given to these facts by the Sub-Committee for rating of speed reducers.

The subject is considered mathematically, and numerous dynamometer cards are included. L. V. W. C.

114. Cleaning Wells in West Texas by Means of Reverse Circulation. D. H. Stormont. *Oil Gas J.*, 3.11.38, **37** (25), 39.—Use of reverse circulation for cleaning wells, following their being shot, has become widespread in West Texas. In some fields the method is used entirely for cleaning out shot-holes.

This method of cleaning out takes advantage of the column of fluid having the highest velocity to carry out cuttings and debris from the hole.

A special kelly and swivel are used, and it is possible to obtain a fluid velocity sufficiently high to carry out cuttings and even large pieces of steel while using a low pressure and low-capacity pumps. L. V. W. C.

115. Supplementary Barrel Checks Scale Trouble in Sucker Rods. J. P. O'Donnell. *Oil Gas J.*, 13.10.38, **37** (22), 61.—Since the introduction of air repressuring in the Middle District fields of Pennsylvania, corrosion of pumping equipment has become acute.

To overcome the deposition of scale, one operating company has developed a simple device which deflects the falling scale from the working barrel into a supplementary outside barrel, from which it can be removed.

The only departure from standard pumping practice when using this supplementary barrel is the drilling of four small-diameter holes in the top of the working barrel to permit ejection of the fluid.

When the well begins pumping, the rise of the liquid in the working barrel lifts the plug or scale deflector from its seat, first opening the ports in the working barrel, and then the top of the working barrel. When the power is shut off, the deflector drops back into the working barrel. L. V. W. C.

116. Repressuring Gives Extended Life to Haynesville. J. C. Albright. *Oil Wkly*, 31.10.38, **91** (8), 31.—The Haynesville field has been given an extended production life by repressuring. The repressured area affects 279 of the 310 oil producers and utilizes thirty-two input wells. An average of 75 million cub. ft. of gas is required to operate this field monthly, with an average daily oil production of about 2300 brls. Since the casing was effectively set, very little workover jobs were necessary to permit the gas to be placed where it would do the most work.

The oil before repressuring had an A.P.I. gravity of from 34° to 34·5°, with the casing-head gas produced carrying up to as much as 10 gals. of gasoline per 1000 cub. ft. Due to solution of gas from repressuring, the gravity of the oil has been raised to an average of 35–35·5° A.P.I., whilst the gasoline content of the casing-head gas has fallen to an average of about 1·35 gals. per 1000 cub. ft.

Casing seats were found to be in excellent condition, and tubing was not used for injection, and packers were not used. Pressures run to as much as 275 lb. gauge, whilst in some cases the sand takes the proper volume with pressures as low as 18 lb.

When an injection well is found to show evidence of channelling, two methods are used. One is to place a higher back pressure on the pumping wells, and the other is to slow down the input volume of gas passing to the input well at fault.

Producing wells are usually tubed high enough so that the sand face is covered with oil at all times. By this clogging of outlet pores is eliminated, with the oil dissolving the paraffin more readily than if pumped dry. L. V. W. C.

117. Pumping is Producing Method in Illinois. G. Triplett. *Oil Wkly*, 14.11.38, **91** (10), 54.—Pumping is the method of well production in the Illinois basin, and only in the McClosky lime fields and in the Salem pool are flowing wells found. The flowing life of lime wells in the McClosky field is only about 3 months, and preparations for pumping equipment are made at the time of completing wells. The life of the wells in the Salem field is not yet known, but long flowing-life is not anticipated, as the few pumping wells show no more than 400 cub. ft. of gas.

In all other sands the wells are put on the pump at the time of completion.

Individual well geared units outnumber central power installations.

The low gas output of sand-producing fields plus the desire to use gas for repressuring compels adoption of energy other than gas. Electricity and gasoline are the principal energies used. L. V. W. C.

118. Solubility Relations and Volumetric Behaviour of Three Gravities of Crude and Associated Gases. J. E. Gosline and C. R. Dobson. *Oil Gas J.*, 18.11.38, **37** (27), 187; *Oil Wkly*, 21.11.38, **91** (11), 34.—A knowledge of the physical properties of reservoir flow is fundamental to a rational treatment of many problems in production engineering.

The results of three mixtures from flowing wells are given, showing such relationships as gas–oil ratio against specific gravity of the gas, the effect of crude gravity on gas gravity for various gas–oil ratios, relationship between gas–oil ratio and factor for conversion of formation volume to specific volume, etc.

The procedure for sampling and experimenting is explained and tables of experimental results are included. L. V. W. C.

119. Oklahoma City Dolomite Wells Show Rapid Production Decline. H. Simms. *Oil Gas J.*, 13.10.38, **37** (22), 49.—Operators in the Simpson dolomite section of the Oklahoma City field are faced by two problems: a rapid decline and an ever-increasing encroachment of salt water.

Production is from the dolomite found from 6380 to 6450 ft., the pay being about 125 ft. thick. Production starts to decrease shortly after completion, and water

appears in ever-increasing amounts as long as the wells flow naturally. The water frequently reaches 60% of the total fluid from the well, but installation of pumps generally reduces the quantity of water, as time is then allowed for partial gravimetric separation of the fluid; production, however, still declines.

Production in this field is uncurtailed because of the water saturation and the small amount of oil involved. L. V. W. C.

120. **Well Potentials are Being Determined by Use of Sound-Waves.** L. G. E. Bignell. *Oil Gas J.*, 1.9.38, **37** (16), 49.—The new method for determining fluid levels in oil wells is by means of "echoes." By producing the well at varying rates and noting the corresponding fluid levels, it is possible to arrive at the capacity of some wells to produce.

The apparatus is known as an "Echo-Meter," and is electrically operated.

A description of the apparatus is given, as well as some practical results.

L. V. W. C.

121. **Surface and Interfacial Tensions of Oil–Water Systems in Texas Oil Sands.** H. K. Livingston. *Petrol. Tech.*, **1** (4), Nov. 1938, A.I.M.M.E. Tech. Pub. No. 1001.—The surface tensions of the oils and waters were measured with a Cenco–du Nouy simplified tensiometer, whilst the interfacial tensions were measured in the Bartell-type apparatus. A study of 40 samples showed a mean value for the surface tension of the oils of 30·4 dynes/cm., with a variation range of only $\pm$ 11%. The surface-tension values of the waters ranged 76 to 49 dynes/cm., with a mean of 66 dynes/cm. The fact that only five waters showed values greater than pure water, although inorganic mineral salts raise the surface tension, points to the presence of surface-active organic compounds, probably dissolved from the oil. The standard deviation of interfacial tension of naturally occurring oil–water systems was 7·3 dynes/cm. from an average value of 20·4 dynes/cm., and neither surface nor interfacial tensions could be correlated with geological age. Antonow's rule cannot be applied to these systems, the interfacial tension instead tending to vary directly as the surface tension of the crude. In general, the surface tension was higher for the denser and more viscous crudes. The temperature coefficient for interfacial tension was about $-0{\cdot}2$ dyne/cm./° F. below 100° F., and $-0{\cdot}1$ dyne/cm./° F. from 100 to 130° F. The interfacial tension was generally higher for the more paraffinic crudes. These results are of value in connection with water encroachment, water flooding, accidental water-flooding and emulsions. G. D. H.

122. **Flow of Oil–Water Mixtures Through Unconsolidated Sands.** M. C. Leverett. *Petrol. Tech.*, **1** (4), Nov. 1938, A.I.M.M.E. Tech. Pub. No. 1003.—The flow of oil–water mixtures through unconsolidated sands was examined for cases in which the physical properties of the liquids, their proportions, the pressure gradients and the types of sand were varied. The concentration of oil within the sand was measured electrically. It was concluded that the relative permeability of an unconsolidated sand to oil–water mixtures is substantially independent of the viscosity of either liquid, but is related to the pore-size distribution, and to the displacement pressure, pressure gradient and water saturation which characterize the process. The effects of these variables are in the direction to be predicted from a knowledge of the Jamin effect. The most probable mechanism of flow appears to comprise segregation of most of the flowing oil in the larger channels between the grains, each channel being substantially full of oil, except at very low oil concentrations when the oil may move as discrete droplets. In either case some oil is thought to be stationary within the sand, whilst the water flows through channels not occupied by oil and, in the present case, as a continuous film around each sand grain.

The data presented substantiate the proposal that the relative permeability of a particular sand to either phase is a function of the water saturation and the dimensionless group $\frac{\pi N}{PD}$ only. G. D. H.

123. **Interfacial Tension Between Water and Oil Under Reservoir Conditions.** C. R. Hocott. *Petrol. Tech.*, **1** (4), Nov. 1938, A.I.M.M.E. Techn. Pub. 1006.—The drop-weight method was used for determining the oil–water interfacial tension in a closed

system in which the pressure and the gas content of the oil could be varied. The oil density was also measured within the closed system. Only sweet crudes were examined, and the interfacial tensions were all of about the same magnitude. The quantity of gas in solution affected the interfacial tension, which increased with the amount of dissolved gas, and consequently with the pressure required to keep that gas in solution. The effect of increasing the pressure on an oil containing a constant amount of dissolved gas was to decrease the interfacial tension slightly. A rough trend existed between interfacial tension and the density of the oil, the higher-gravity oils having lower interfacial tension against water. The surface tension of water against gas is greatly influenced by the pressure of the gas, ranging from values near that of pure water against air at atmospheric pressure, to values approaching the interfacial tension of water against crude oils at pressures in the neighbourhood of 3000–4000 lb./in.^{2}. G. D. H.

124. Production Patents. G. A. Macready. U.S.P. 2,137,296, 22.11.38. Well fluid sampler.

D. W. Hoferer and E. T. Adams. U.S.P. 2,137,402, 22.11.38. Pump-valve construction.

D. W. Hoferer. U.S.P. 2,137,403, 22.11.38. Well pump.

T. E. Bryan. U.S.P. 2,137,441, 22.11.38. Gas lift valve.

H. Waller. U.S.P. 2,137,599, 22.11.38. Oil-well line-control device comprising a casing having a port in the side, a barrel and means for attaching it to the upper end of the well, a slide valve for closing the upper end of the casing and a lever for operating the valve, and a valve to close the port. Means is provided for opening the port valve as the slide valve closes.

J. D. Nixon. U.S.P. 2,137,853, 22.11.38. A polish rod device, including a guide sleeve, a socket on the end of the guide sleeve, a rotatable head connected to the socket and gripping means within the head for securing the device on to the polish rod. Packing is arranged to be deformed by the gripping means for forming a fluid-tight seal between the sleeve and the rod.

H. Salvatori. U.S.P. 2,137,985, 22.11.38. Method of logging a well by means of seismic waves.

W. E. Bendeler. U.S.P. 2,137,997, 29.11.38. Device for sealing between two telescopically related strings.

J. E. Hall. U.S.P. 2,138,002, 29.11.38. Well pump.

A. Hollander. U.S.P. 2,138,032, 29.11.38. Semi-submersible motor well-pump.

A. L. Armentrout and E. B. Hall. U.S.P. 2,138,057, 29.11.38. A method of testing the formation by positioning a perforated liner in the well carrying a drillable packing means lowered on a test string. The test fluid is allowed to enter the liner, and is removed, as is the string. The packing means is left in the well, and is then drilled up, leaving the well clear for further operations.

E. P. Halliburton. U.S.P. 2,138,156, 29.11.38. Well packer.

E. P. Halliburton. U.S.P. 2,138,157, 29.11.38. Removable packer for wells.

J. Grant. U.S.P. 2,138,375, 29.11.38. Well cleaning apparatus.

C. C. Brown. U.S.P. 2,138,569, 29.11.38. Well packer.

L. Spencer. U.S.P. 2,139,101, 6.12.38. Hydraulic pumping-jack.

W. T. Wells. U.S.P. 2,139,104, 6.12.38. Pressure-equalizing and surge-relief device for gun perforators.

W. T. Wells. U.S.P. 2,139,105, 6.12.38. Well fluid-pressure gauge.

W. H. Stigall. U.S.P. 2,139,319, 6.12.38. Tubing bleeder and jar.

G. Potapenko. U.S.P. 2,139,460, 6.12.38. Method of determining the presence of a substance having a selective effect with respect to frequency of an imposed electric field.

W. B. Lerch and T. M. White. U.S.P. 2,139,595, 6.12.38. Method of cleaning wells and well strings of deposits of paraffin wax, which consists of introducing into a well a water-miscible liquid wax solvent in the form of a column of liquid hydrocarbons, containing a small portion of modified fatty acid saponifying agent and flake naphthalene, and causing the column to be reciprocated up and down to dissolve the paraffin wax. L. V. W. C.

Transport and Storage.

125. Calculation of Venting Requirements for Low-Pressure Oil Storage-Tanks. L. Bosa. *Oil Gas J.*, 18.11.38, **37** (27), 196; *Oil Wkly*, 21.11.38, **91** (11), 19.—A tentative standard method for the calculation of venting requirements is outlined. The application of this method to specific cases is in reasonable agreement with available experimental data and with current practice.

Since tank breathing is due to variations of the thermal conditions inside the tank, or to volumetric displacement due to the operations of filling and emptying, pressure or vacuum thermal breathing and pumping-in or pumping-out breathing are considered in this method.

A nomographic chart for the calculation of the venting requirements for low-pressure oil storage-tanks is included. L. V. W. C.

126. Evaporation Losses of Petroleum Oils from Steel Tanks. C. C. Ashley. *Oil Gas J.*, 18.11.38, **37** (27) 170; *Oil Wkly*, 21.11.38, **91** (11), 13.—The investigation was undertaken in an effort so to correlate and compare all available tank evaporation-loss data that charts might be prepared to assist in making predictions of expected evaporation losses under given conditions, and in deciding on desirable roof construction or tank-venting facilities. More than thirty separate articles and reports covering over 200 individual tests have been reviewed. The original data were secured by various test methods. Owing to leakage losses, quantitative methods based on measurement of (*a*) vapours lost, or (*b*) changes in oil volume are only to be recommended as a check on other more accurate methods. Of the qualitative tests determined by change of (*c*) distillation characteristics, (*d*) composition of oil with respect to the most volatile fractions, (*e*) vapour pressure of the oil, the last-mentioned is regarded as the most accurate. The method of Chenicek and Whitman modified with respect to sampling method is considered the best available for the purpose.

The basic factor utilized in this work is the vapour pressure of oil at the average temperature of the tank, as it is considered that for all practical purposes the correction to the oil temperature eliminates from consideration all variables of weather, tank size and painting. This view is supported by a graph showing relation of atmospheric temperature to temperature of standing oil in steel storage-tanks based on data from tanks of various construction, capacity and degrees of filling, in tests of 5–62 days' duration. From the test data available, oil temperatures were calculated, where necessary. A correlation between Chenicek and Whitman vapour pressure at 75° F. and Reid vapour pressure at 100° F. was established. Curves are plotted to show: (1) evaporation loss from standing for full cone-roof tanks with and without vent-valves and tanks with pan-type floating roofs; (2) evaporation loss from cone roof-tanks due to pumping in; the Reid vapour pressure at 100° F. and average temperature of oil in the tank being related to evaporation loss in gals. per sq. ft. of oil surface per month in the first case, and to loss expressed as percentage of innage volume in the second. Breathing losses from breather roof-tanks standing full were negligible, and data for other types of roof not adequate. In plotting the curves of the first series, preference was given to tests by vapour-pressure methods over tests by gauging. Insufficient data were available to plot curves desired for variation of evaporation loss from cone roof-tanks with (3) degree of filling, (4) increase of vent-valve operating pressure. The data on which the report is based are derived from oils of relatively low Reid vapour pressure, and will probably not apply to oils of

high vapour pressure, owing to latent heat of evaporation effects if tank temperatures reach the boiling point of the product. The vent-valve pressures were of the order of 1–1½ in. of water, but appreciable reductions in evaporation losses are reported where higher tank pressures are employed. A suggested procedure for compilation of data and testing is given with a view to standardization and the subsequent availability of more accurate data upon which to build. R. A. E.

Crude Petroleum.

127. Eastside Coalinga Field. California Crude Oil. Anon. *Petrol. Engr*, Nov. 1938, **10** (2), 76.—A Bureau of Mines analysis of a sample of crude oil from Eastside Coalinga field, Fresno County, California indicates that it is an intermediate base oil with a gravity of 33·4° A.P.I. and a sulphur content of 0·22%. Yields on distillation are: light gasoline 7·0%, total gasoline and naphtha 26·9%, kerosine distillate 4·4%, gas oil 22·6%, non-visc. lub. dist. 11·3%, med. visc. lub. dist. 7·0%, visc. lub. dist. 1·9% and residuum 23·0%. C. L. G.

128. Hydrocarbons in the Lubricant Fraction of Petroleum. F. D. Rossini. *Oil Gas J.*, 18.11.38, **37** (27), 141.—In connection with A.P.I. Research Project 6 a 10% fraction from crude oil from Brett No. 6 well in Ponca City, Oklahoma, has been separated into four broad fractions by solvent extraction and silica gel treatment. The fractions are: "wax" portion (35%), "asphaltic" portion (8%), "extract" portion (22%) and "water-white" oil portion (35%). The physical properties of the last two fractions are shown, and they were further fractionated exhaustively by distillation and extraction. Substantially constant-boiling fractions were then subjected to extraction. Each of the final "homogeneous" fractions was of the order of 15 gms., representing 1/40,000th part of the original crude, and consisted of compounds of substantially similar size and type. They appear to be nearer to pure compounds than any material, except *n*-paraffins, hitherto separated from the lubricating fraction of any crude. The "water-white" fraction was found to be substantially pure hydrocarbon material, and contained no sulphur, nitrogen or oxygen in significant amounts, whereas fractions from the "extract" portion contained about 0·9% sulphur, 0·1% nitrogen and 0·5% oxygen. The distribution of these elements in the fractions is discussed. On all important final fractions, ten properties were determined, and from some of these molecular formulæ, specific refractions, specific dispersions and kinematic viscosity indices were calculated. Certain fractions were subjected to hydrogenation and subsequently analysed to assist in determining composition of the fractions.

An illustration is given of the actual procedure followed in deducing the general identity of one of the final "homogeneous" fractions. Some of the correlation charts showing specific refraction, specific dispersion and aniline point plotted against number of carbon atoms per mol. are presented. Further charts, concerning the extract fractions, relate percentage extracted with methyl cyanide to b. pts. at 1 mm. pressure, kinematic viscosity at 100° F. and the kinematic viscosity index of one of the substantially constant-boiling fractions both before and after hydrogenation. Conclusions regarding the particular oil fraction tested are that: (1) about 43–51% of the lubricating fraction is composed of molecules with 1, 2 or 3 naphthene rings, together with appropriate paraffin side-chains; (2) about 8% as in (1), but with 1 aromatic ring; (3) about 8·1% with 2 naphthene rings and 2 aromatic rings (condensed), together with appropriate paraffin side-chains; (4) about 6·6% with 1 naphthene ring and 3 aromatic rings (condensed) with appropriate paraffin chains; (5) about 18–26% *n*-(straight chain) paraffins plus possibly some *iso*-paraffins (branched-chain); (6) about 8% of "asphaltic" constituents. Division of these types amongst the four fractions is discussed and shown in tabular form. An effort to separate pure hydrocarbons from a large quantity of a dewaxed lubricant fraction of Mid-Continent crude is under way, and further work on the "wax" and "asphaltic" portion of the crude discussed in the present report is desirable. The insight obtained into the composition of oil will assist in the manufacture of oils from crude for special purposes and in the production of synthetic lubricating and other oils. R. A. E.

129. Chemical Constitution of the Extracts Portion of the Lubricants Fraction from a Mid-Continent Petroleum. B. J. Mair, C. B. Willingham, and A. J. Streiff. *Industr. Engng Chem.*, 1938, **30** (11), 1256.—A correlation is made of the properties of 179 fractions of oil prepared by extensive distillation and extraction of the extract portion of the lubricants fraction from a Mid-Continent petroleum. From a critical survey of the data the following conclusions are reached :—

(1) About 60% of the material consists of naphthenes with one to three rings per molecule ;

(2) About 15% of the material consists of molecules with one aromatic ring and from one to three naphthenic rings per molecule, and with this material is associated a small amount of sulphur and oxygen compounds ;

(3) About 14% of the material consists of molecules with two aromatic rings (linked through two common carbon atoms) and about two naphthenic rings per molecule, and with this material is associated a small amount of oxygen and sulphur compounds ;

(4) About 11% of the material consists of molecules with more than two aromatic rings and one or two naphthenic rings per molecule, and with this material are associated some sulphur, nitrogen and oxygen compounds.

J. W. H.

Gas.

130. Patents on Gas. G. W. Johnson. E.P. 495,129, 8.11.38. Improved apparatus for the removal of foreign gases from circulation in catalytic pressure reactions.

Usines de Melles. E.P. 495,304, 10.11.38. Separation of olefines from gaseous mixtures by means of a preferential solvent for olefines, in a plurality of stages.

Standard Oil Development Co. E.P. 496,159, 25.11.38. Method of controlling temperatures in exothermic catalytic gas reactions. W. S. E. C.

Cracking.

131. Cracking of Kerosine in the Presence of Catalysts. C. Otin and S. Savencu. *Petrol. Z.*, 1938, **34** (46), 1.—A kerosine was heated under 1, 10 and 20 atm. pressure respectively at different temperatures for varying periods of time, both with and without catalysts (metals, oxides, chlorides, sulphates, etc.). The formation of gasoline was checked by specific gravity and distillation tests. In absence of catalysts, at atmospheric pressure (170° C.) and at 10 and 20 atm. (150–240° C.), no significant production of gasoline occurred on heating for 2–10 hrs.

In the experiments which employed catalysts the heating period was 2 hrs. in every case. Metals (K, Na, Ca, Zn, Al, Mg) and oxides (MgO, CaO, ZnO) had only a very small effect at 10 and 20 atm. The best yield of gasoline (6%) was obtained with MgO. Of the salts, $AlCl_3$ was by far the most effective in promoting cracking. At 250° C. (20 atm.) 31% gasoline was produced. The effect of time on the catalytic effect of $AlCl_3$ was studied separately. After 10 hrs. at 20 atm., 55% gasoline was obtained.

As a general result, it was concluded that in the absence of catalysts the influences of time and pressure were insignificant, but had an important effect when an efficient catalyst was used. P. G. H.

132. Corrosion-Resistant Steels in Cracking Plants. E. S. Dixon. *World Petrol.*, Annual Ref. Issue, 1938, **9** (11), 72.—The experience of a major oil company in the behaviour and economic value of corrosion-resistant steels in cracking service is outlined.

Carbon steel is usually preferred for the construction of vessels such as soaking drums and towers which can be protected by liners. For furnace tubes, bubble-tower angle iron tray supports, outside lines, cast valves and return bends, 4–6 Cr steel shows a service life of 3/20 times that of carbon steel, depending on the severity of corrosion, temperature, presence of protective coke deposits, etc. Plain Cr steel

tubes are liable to cold brittleness, but this disappears when heated, so that tubes should be warmed when knocking with coke-cleaning tools. The addition of Mo prevents this cold brittleness. The proper selection from the wide variety of alloy steels now available requires a complete knowledge of the particular conditions obtaining, so that designers sometimes build with carbon steel in order to determine where conditions are severest, etc. For relatively non-corrosive conditions 4–6 Cr–Mo steel is uneconomic and 2% Cr–Mo steel provides satisfactory service, but for severer conditions 4–6 Cr–Mo or 18–8 Cr–Ni steels are used. The air hardening during welding of Cr steel tubing in outside pressure lines can be prevented by annealing, for which an electric furnace has been developed. The Zeiss bore inspection telescope is used for the detection of defects in bores of hot-oil pumps. Liquid ends of hot-oil pumps have been reclaimed by re-machining oversize the ports and passages of the cylinders, filling with molten metal of 4–6 Cr composition and re-machining. The liner should be 5/6 times more resistant to corrosion than the ordinary forged carbon cylinder. C. L. G.

133. Patents on Cracking. P. Ostergaard. U.S.P. 2,134,926, 1.11.38. Cracking of petroleum oils in which cracked products which are too low-boiling for use as commercial motor fuel are polymerized or cracked and then polymerized in a recycling operation.

W. E. Currie. U.S.P. 2,135,068, 1.11.38. Production of blended motor fuels of high anti-knock value and containing both polymerized and hydrogenated gasoline with or without cracked gasoline or absorption gasoline.

G. C. Peckham. U.S.P. 2,135,876, 8.11.38. Cracking of petroleum oils by direct contact with a suitable molten metal or inorganic salt heated to cracking temperature. W. S. E. C.

Hydrogenation.

134. Evolution of Processes for Preparing Gasoline by the Catalytic Reduction of Carbon Monoxide by Hydrogen. C. Berthelot. *Chim. et Ind.*, 1938, **40**, 434–460.—The author considers that the commercial production of motor spirits by the direct hydrogenation of solid fuels is approaching its culminating point. On the other hand, the hydrogenation of liquid fuels, such as primary tars, oils from schists, petroleum residues, etc., has possibilities of great expansion.

The Fischer–Tropsch synthesis by which liquid fuels are prepared by the reduction of CO by H_2 is examined, and methods for preparing the gaseous mixture are discussed.

Instead of starting with the theoretical mixture $CO + 2H_2$ which is required by the Fischer process, it is possible to use ordinary water gas in a modification of the process suggested by Myddleton. This gives a lower yield of liquid products, but the resulting spirit has a higher octane number, due to less complete hydrogenation and the consequent higher content of olefines.

Methods for purifying the gases are discussed and the effect of various catalysts is described.

It is concluded that the best process, in general, is one combining the destructive hydrogenation of liquid products formed by distillation of solid fuels with the catalytic reduction of the water gas formed from the residual coke.

This can be carried out in one plant. D. L. S.

135. Catalytic Hydrogenation Under Pressure of Albanian Crude and Products Obtained with Special Consideration to Gasolines. S. Doldi. *Chim. e Industria*, 1938, **16**, 530–535.—The advantages of processing sulphur-rich asphaltic-base Albanian crude by hydrogenation are pointed out and the principles governing the process are outlined, with considerations on the influence of temperature, pressure and nature of catalyst. The various methods of processing the topped Albanian crude and the products obtained by catalytic hydrogenation under pressure are described. By the liquid phase process, with finely divided catalyst, medium and heavy stocks are obtained in great quantity, together with small amounts of naphtha. The selection of a particularly active catalytic agent is essential, since the latter, when finely divided in the

charging stock, prevents asphalt separation and ensures satisfactory hydrogenation. The characteristics of products obtained are described, the naphtha having an octane number of about 60, good stability, and very low sulphur, and is thus superior to the naphtha obtained by topping. Hydrogenation using a fixed catalyst is discussed, and difficulties encountered in this procedure are mentioned, pressures of about 600–700 atm. and suitable catalysts and catalyst blends are necessary. Hydrogenation in vapour phase is employed to convert medium oil into naphtha; this process is characterized by the high concentration of the catalyst used. The naphtha produced by this process requires no treatment other than an alkali wash. Two processes for vapour-phase hydrogenation are described, in one of which the product is automotive fuel and in the other aviation fuel. Using higher pressures and special catalysts, it has been possible to obtain from the Albanian medium stock an aviation naphtha of 77 octane number. P. G.

136. Destructive Hydrogenation of Roumanian Paraffin Wax. C. Candea and L. Sauciuc. *Petrol. Z.*, 1938, **34** (50), 1.—A commercial, Roumanian paraffin wax, s. pt. 53·7° C., was simultaneously cracked and hydrogenated at different pressures, temperatures, and with variations in the free reaction space. Experiments were made with and without catalysts. When no catalyst was used, the products were unsaturated in character. In the presence of MoS_2 at 430° C., and with a small reaction space, marked cracking with hydrogenation occurred, but the light products so obtained contained considerable proportions of unsaturateds. With a larger reaction space, however, the products were practically saturated (MoS_2 catalyst, 430° C.). P. G. H.

137. Synthesis of New High-Molecular-Weight Paraffins. H. Pichler. *Petrol. Z.*, 1938, **34** (38), 1.—In a study of the use of noble metals (Ru, Os, Pt, Ir, Rh, Pd) as catalysts for hydrogenation of carbon monoxide, it is shown that ruthenium in particular is far more effective than the more usual Fe, Co, or Ni in producing solid hydrocarbons. By a single passage of CO/H_2 mixture (1 : 2) at a speed of 1 litre/1 gm. Ru/1 hr. over the catalyst at 195° C. and 100 atm. pressure, 140–150 gms. solid and liquid hydrocarbons were obtained per normal cu. metre of "synthesis" gas. Working temperature and yields remained constant for 6 months in one particular experiment. Of the yield of hydrocarbons about 100 gms. per N cu. metre consisted of crude, white paraffin (m. pt. 118–119° C.); by treatment with solvents it was possible to isolate from the crude paraffin hitherto unknown solid paraffin hydrocarbons with m. pts. up to 132° C. and molecular weights 7000–9000. P. G. H.

138. Patents on Dehydrogenation. Universal Oil Products Co. E.P. 496,045, 22.11.38. Dehydrogenation of propane and butane for the production of aviation spirit.

C. Ellis. U.S.P. 2,137,275, 2.11.38. Process of reconstituting and dehydrogenating heavier hydrocarbons for the production of anti-knock motor spirit, *i.e.*, conversion of heavy hydrocarbons with a limited formation of free hydrogen by bringing together the hydrocarbons and only an inert gas which does not enter into the reaction, and treating the mixture at temperatures above 350° C. and pressures of 300 atm. W. S. E. C.

Polymerization.

139. Gases from Skimming and Cracking Units are Polymerized to Form Gasoline. J. C. Albright. *Petrol. Engr*, 1938, **10** (2), 78.—A description with flow sheet and analytical data is given of an Alco-Pure polymerization unit operating on Gyro-cracked gases at a refinery in Javella, La. The polymer plant handles 3,720,000 cu. ft. of cracked gas and 264,000 cu. ft. of recycle gas. The cracked gases are scrubbed to remove H_2S and compressed in two stages to 450 lb., the liquids removed being compressed to 370 lb., and both passed to the pyrolysis coil at about 90° F., where they are heated to about 1000° F. From there they pass to the polymerization coil, the reaction products being quenched to 440° F. and passed to a high and a low pressure

separator. The liquids are stabilized, giving liquids of desirable vapour pressure and an overhead gas which is liquefied for recycling through the polymer plant. The polymer liquid is pumped to the Gyro distillate feed and fractionated after being processed in clay chambers, the polymer bottoms being separated and passed to the Gyro-cracking unit feed-stock.

Analyses are given of the Gyro gasoline and of the mixture with polymer gasoline, the octane numbers being 70·2 and 72·3, respectively. C. L. G.

140. Phenol-Modified Indene Coumarone Resins. J. Rivkin and W. F. Sheehan. *Industr. Engng Chem.*, 1938, **30** (11), 1228.—The effects of varying the ratio of phenol to indene and indene-type unsaturateds in the polymerization reaction, taking place in the presence of an activated clay catalyst, is investigated and the properties of the resulting resins are discussed. J. W. H.

141. Patents on Polymerization. G. W. Johnson and I.G. Farbenindustrie A.-G. E.P. 495,121, 8.11.38. Conversion of olefines into liquid hydrocarbon products by polymerizing them in the presence of anhydrous aluminium chloride catalyst and perchlorethylene.

G. W. Johnson and I.G. Farbenindustrie A.-G. E.P. 495,184, 4.11.38. Catalytic polymerization of olefines into liquid hydrocarbons, using several separate reaction vessels.

W. W. Groves. E.P. 495,337, 11.11.38. Manufacture of resinous products by polymerization of a vinyl ester and crotonic acid.

Universal Oil Products Co. E.P. 495,477, 9.11.38. Conversion of paraffin hydrocarbons into olefines and then by polymerization into lubricating oils.

G. W. Johnson. E.P. 496,267, 24.11.38. Preparation of phosphoric acid catalyst.

L. F. Brooke. U.S.P. 2,135,793, 8.11.38. Preparation of phosphoric acid catalyst for polymerization processes.

J. W. Throckmorton. U.S.P. 2,135,923, 8.11.38. Production of high anti-knock motor fuel from gases rich in unsaturateds which have been liquefied and polymerized to convert the gases into gasoline.

W. N. Davis. U.S.P. 2,136,785, 15.11.38. Catalytic polymerization of normally gaseous olefines into liquid motor fuels, using a phosphoric acid film catalyst.

J. Hyman. U.S.P. 2,137,492, 22.11.38. Polymerization of unsaturated hydrocarbons containing diolefines, using granular, porous, synthetic complex silicates containing an Al ion.

F. E. Frey. U.S.P. 2,138,541, 29.11.38. Multi-stage polymerization process for converting normally gaseous hydrocarbons into motor fuels.

R. F. Ruthruff. Re. 20,931, 29.11.38 (cf. U.S.P. 2,017,325, 15.10.35). Improved polymerization process carried out at 850–1000° F. and under 500–2000 lb. pressure/sq. in. The fixed gases are separated from the products under high pressure and at relatively low temperatures and eliminated from the system. The remaining gases are separated from the liquid products in at least two subsequent stages at progressively lower pressures, and the gases rich in olefines separated from at least one stage and recycled for polymerization. The gases of low olefine content, separated in other stages from the system, are eliminated. W. S. E. C.

Refining and Refinery Plant.

142. Refining Gasoline with Solid Phosphoric Acid Catalyst. V. N. Ipatieff and B. B. Corson. *Industr. Engng Chem.*, 1938, **30** (11), 1316.—Experiments are described on the vapour-phase refining of gasoline with a solid phosphoric acid catalyst. The charging stock was untreated stabilized distillate obtained by cracking West Texas

crude oil. The catalyst was prepared from a mixture of diatomaceous earth (Sil-O-Cel) and commercial orthophosphoric acid, and the plastic mass was then heated to 250° C. for several hours, cooled, the solid cake broken up and screened to a convenient size. The following table exhibits results obtained in a typical experiment.

Refined gasoline :—		
Barrels per ton of catalyst		5565
Barrels per ton per hour		10·3
Polymer, per cent. yield by volume		8·9
Hours on Test :—		
Treating		541
Regenerating		114
Operating Temperature :—	° F.	° C.
Preheater	520	271
Flashed vapour	440	227
Catalyst	350	177
Reboiler	435	224
Overhead vapour	255	124

Polymer formation can be decreased by using a shorter contact time and also by introduction of steam with the charging stock. Further, under the experimental conditions employed no cracking to gases occurred. Regeneration of the catalyst was accomplished *in situ* by air oxidation at 900° F. (482° C.). Fresh catalyst produced the equivalent of 1950 barrels of distillate per ton of catalyst, of good colour. The high-boiling polymer produced as a by-product has the characteristics of a drying oil, hardening to a resin on exposure to air. In addition, the phosphoric acid catalyst is shown to be superior to clay (Attapulgus) as a refining agent. H. E. T.

143. Factors in Doctor Sweetening. C. D. Lowry, C. G. Dryer, C. Wirth and R. E. Sutherland. *Industr. Engng Chem.*, 1938, **30** (11), 1275.—The use of excess sulphur in doctor sweetening has been found to influence adversely the effectiveness of oxidation inhibitors in sweetened gasoline. With adequate mixing of doctor solution, gasoline and sulphur at a temperature of not less than 85° C., followed by adequate settling, it is possible to produce a gasoline in which inhibitors will be consistently effective. The harmful effects of excess sulphur are apparently due to the formation of polysulphides, particularly those higher than trisulphides, which remain in the gasoline. J. W. H.

144. High Butane Recovery by High-Pressure Absorption. F. G. Noble. *Petrol. Engr*, Nov. 1938, **10** (2), 29.—A description with flow diagram, photographs, typical plant and data analyses is given of a high-pressure absorption process for butane extraction at Kilgore, Texas. The plant has a daily capacity of 8,250,000 cub. ft. and is designed to recover 95% of the butane. The compression plant operates in two stages, the first discharging gas at 38 lb. into four horizontal coolers whence condensate is removed, and the second discharging gas at 305 lb. pressure into three vertical high-stage gas coolers. Liquid is separated, and both streams are processed through the absorption distillation unit. The gas is delivered to a 64 ft., 24-tray absorber operating at the unusually high pressure of 300 lb. Four water intercoolers are used to restrict temperature rise of the absorption oil, whilst controls maintain a constant gas–oil ratio. Rich oil is vented into a tank at 130 lb. and the vapours pass to a 52-ft. 30-in.-diameter stripper still operating at 90 lb. pressure, whilst the oil passes through three stripper heat exchangers and a preheater into the stripper still.

In this unit the dissolved hydrocarbons in the feed, plus a small amount of absorption oil, are stripped overhead by steam entering the bottom of the tower where a high temperature is maintained by a reheater, in the return line of which the vapours from the rich oil vent tank are introduced. The overhead material from the stripper passes via a heat exchanger and two vertical stripper condensers into an accumulator, and thence into a vapour liquid separator, the gas being combined with the gas streams from the gasoline vent tank and still accumulator. After entering, the gas joins the liquid from the vapour liquid separator to form the total reabsorber feed. Vapours from the gasoline flash-tank entering the feed are obtained by flashing the high-stage

separator liquid from 300 to 130 lb. pressure. The flashed vapours pass through a back-pressure regulator directly to the reabsorber feed. The reabsorber is a 50-ft. by 30-in.-diameter tower operating at 85 lb.

The main still is a 52-ft. by 36-in.-diameter combination still and rectifier equipped with a reheater in the lower or stripper section. The still overhead enters two horizontal condensers where it meets the liquid from the gasoline flash-tank, both liquids then passing via a final sub-cooler into a still accumulator. The liquid product passes into a stabilizer raw-gasoline surge-tank, whilst the vapours are returned to the reabsorber. Lean oil from the still is combined with that from the stripper still, and after heat exchange passes to the lean-oil surge-tank for recirculation through the plant. Raw gasoline is charged to a 51-ft. by 36-in.-diameter stabilizer, the stabilized gasoline being heat exchanged and cooled, whilst the vapours are condensed and passed to an accumulator, the uncondensed vapour being utilized in the field residue system.

C. L. G.

145. Revivification Characteristics of Bauxite Used in Filtration. R. H. Hubbell and R. P. Ferguson. *Oil Gas J.*, 18.11.38, **37** (27), 135.—Previous work on bauxite has shown that in the percolation of residual stock, optimum results are obtained by operation at maximum practical temperatures of burning and filtration, whereas for decolorizing light-coloured distillate stocks minimum temperatures are best. A "solvent" effect, accompanied by a drop in oil viscosity, is exerted by new bauxite, but this is substantially lost after continued reburning. In the present work an analysis is made of the effect of revivification on decolorizing value and "solvent" effect of bauxite using plant-revivified samples from percolation of a variety of residual stocks, neutral and acid-treated distillates, dewaxed bright stocks and Pennsylvania petroleum stock. The conclusions are derived largely from operation of a plant in which bauxite is utilized through nine reburnings for distillate filtration, using low burning temperatures, followed by revivification at 1250–1300° F. for use in residual stock filtration. The relative efficiencies of new and revivified bauxite and new fuller's earth are compared. The results are presented in the form of graphs and of tables, which show properties of the oils before and after filtration as well as filtration and burning temperatures, absorbent density and percolation efficiencies on weight and volume bases. It is shown that whereas with fresh bauxite there is an appreciable reduction in specific gravity and Conradson coke value of the oil filtered, after several reburnings specific gravity and coke values are similar to those obtained by filtration through fuller's earth. Furthermore, as bauxite passes through several revivifications, the finished-oil cast improves until a point is reached at which the bloom is comparable to that imparted by fuller's earth. In general, the lower the numerical A.S.T.M. colour of finished oil from a given stock, the greater the reduction in efficiency of bauxite on revivification. After a certain number of burnings the efficiency reaches a practically constant figure for a given colour from each type of oil. The original efficiency of bauxite compared with fuller's earth varies according to the type and origin of stock, and so does the drop in efficiency on revivification. Bauxite shows to great advantage in the treatment of petrolatum, but drops rapidly in efficiency on revivification when used for treating Colombian distillate stock. Economic comparisons show bauxite to possess an advantage over fuller's earth in the decolorization of petrolatum stocks, residuals and of distillate stocks—provided that a balance is maintained, whereby bauxite, in its early stages, is segregated for distillate filtration. The use of bauxite for paraffinic distillates exclusively has been shown to be a borderline case. Selection of absorbent for a given service thus remains an individual problem for the solution of which the data presented provide a basis. R. A. E.

146. Curious Case of Increase in Decolorizing Power of a Mixture of Two Decolorizing Earths. II. E. Erdheim. *Przem. Naft.*, 25.12.38 (**24**), 656. (For Part I see Abstract No. 50).—It has been shown in Part I of this investigation that a mixture of two decolorizing earths "G" and "S," of low and high decolorizing powers respectively, had stronger decolorizing properties than would be expected from an arithmetical addition of their respective decolorizing powers, 3% of a mixture of "G" and "S" in different proportions being added to an oil 9/10° E_{50}.

In the second series of experiments this proportion was fixed at 25–75 "G," and the percentage amounts of the mixture added to the oil were being varied. Thus 0·5,

1·5, 3·0, 4·5% of the mixture were added to the oil. The results were again higher than those calculated from the decolorizing powers of the two earths. It was shown that these anomalies were not constant, but increased from 3·7 to 8·2% with increasing additions of the mixture.

A diagram is given illustrating the results obtained. E. J. W.

147. Liquid-Liquid Extraction in the Separation of Petroleum Acids. H. G. Schutze, W. A. Quebedeaux and H. L. Lochte. *Industr. Engng Chem.* (*Anal.*), 1938, **10** (12), 675–677.—Two rotary columns for counter-current extraction are described, one for the removal of the stronger acids first, the other for the weaker first. In the former case, between the upper and lower separating sections is the column proper, consisting of a glass tube within which a smaller rod is rotating at 200–500 r.p.m. The column is filled with a solution of the petroleum acids in petroleum ether to just below the upper section. 0·1*N*-KOH is added at the top at two drops per second, and 0·4*N*-H_2SO_4 near the bottom at such a rate that there is a slight excess of acid. The drops of the potassium salt solutions descend until they reach the acid inlet, where the free acids are liberated. Some dissolves in the descending water spiral, whilst most of the acids diffuse upwards, where interchange with descending potassium salt takes place, stronger acid replacing weaker. When 1 litre of KOH has passed, the aqueous layer is extracted with petroleum ether and added to the top of the column. The next litre of aqueous phase is extracted for cut 1, the next for cut 2, etc.

The other column is constructed on similar principles, and the results obtained on this separator with a complex petroleum acid mixture are quoted. Attention is also directed to the great advantages of fractional distribution, based on differences in K_a values and in structure, as a supplementary method to fractional distillation.

T. T. D.

148. Liquid Entrainment Separators. G. M. Kirkpatrick. *Industr. Engng Chem.*, 1938, **30** (11), 1207.—A non-mathematical analysis is given of the action of entrainment separators. The various factors affecting the performance are discussed in relation to combination centrifugal and contact surface and purely contact surface separators. Some figures are given for the capacities of the two types. P. D.

149. Study of Recovery of Oil from Spent Percolation Filters. C. M. Ridgway, L. M. Henderson and W. B. Ross. *Oil Gas J.*, 18.11.38, **37** (27), 154.—The investigation was limited to the fuller's-earth type of adsorbent and to Pennsylvania oils. The effect of viscosity on soakage (filling of voids between grains), draining and oil retention was determined by experimenting with neutral oils at 130° F. and bright stock at 200° F. Drainage decreases slightly with increased viscosity. The effects on washing efficiency of the variables volume, rate of addition and temperature of wash and type of naphtha used have been ascertained. Experience indicates that earth returned to the burner should not contain more than 2½% by weight of oil. An experiment carried out at 130° F. indicated that this was possible with neutral oils using reasonable amounts of wash, but excessive amounts of wash were required for the bright stock. A study was made of the soaking, draining and washing of Pennsylvanian cylinder stock solution filters in a plant equipped with filters of 35 tons nominal capacity of Florida fuller's earth, 16–30 mesh. Cleanliness of screen was found to be of prime importance in respect of drainage rate as well as total drainage. Factors affecting subsequent washing were examined, and attention was given to properties and filterability of oil recovered at various stages. Following the use of 11 brls. of naphtha per ton of clay, when oil content was 4·2% by weight of clay, steam was introduced to recover solvent and the oil content of the clay was reduced to 1·1% by weight. Effects of using recycle wash were also examined. The conclusions reached are summarized as follows :—

1. In plant filters the rate of draining and the total amount drained are dependent primarily on the condition of the screen.
2. In naphtha washing a low uniform washing rate is desirable.
3. The first portion of the washing naphtha should be applied at a temperature below that of the filter, and in such volume as is necessary to remove the filterable oil. The subsequent washing naphtha should be added at a temperature

above that of the filter for the purpose of dissolving an increased proportion of the tar.

4. A paraffinic naphtha of low vapour pressure and low end-point should be used in washing.

5. An appreciable increase in the viscosity of the original charge increases the amount of naphtha necessary to reduce the oil content of the filter to a specific magnitude.

6. The colour of the cylinder stock recovered in the clay wash is not indicative of its filterability.

7. The filterability of the oil contained in the washings is at present the only criterion that can be used in judging the fraction to be returned to the blend tank for reprocessing.

8. Clay-wash cylinder stock should not be blended with stocks of better filterability, inasmuch as this material decreases the filter yields to a much greater extent than its arithmetical proportion.

9. When recycle wash is used, extreme care must be taken to avoid introducing into the system material of poor filterability. R. A. E.

150. Continuous Residuum Coking by Delayed Coking Process. R. J. Kiwoky. *Oil Gas J.*, 18.11.38, **37** (27), 131.—The "delayed coking" process developed by the Standard Oil Co. (Indiana) has been in commercial operation for several years, and has been applied to reduced crude and in a combination crude-running and cracking plant. The plant described was constructed in 1930, and has a capacity of 2860 brls. per day of Mid-Continent reduced crude of 19·0° A.P.I. gravity. Reduced crude at a temperature of 685° F. is pumped to the furnace, a typical radiant—and convection—section heater. Feed enters at the bottom of the convection section and passes upwards counter-current to the flow of gases. Parallel flow through two tubes is employed in the lower half and series flow in the upper half. The oil then enters the radiant section, in which only series flow is employed. The radiant section contains tubes on each side wall and on the front wall, and the hot oil passes in a U-shaped path through the lowest tubes on the three walls, then back over the reverse route in the second lowest tubes, and so forth. After passage through the wall tubes the oil flows through a single row of roof tubes, leaving the furnace normally at 910° F. Firing is controlled by the oil-exit temperatures. The residuum then enters a "circulating ring" flowing around in two directions from the point of entrance, the flow in each leg being regulated by manually operated valves and controlled by temperature. The two streams meet at the point of exit and enter the coking-drum, and in this way the undesirable deposition of coke at various points is avoided and diversion of the stream from one drum to another is facilitated. Three coking-drums are provided for continuous operation. Flow of oil is at a uniform rate, until the drum is filled with coke, the time required being determined by previous experience. The drums are of riveted construction and of special design, coke removal being effected by cable pulling followed by hand removal from walls. The method of fixing cables and the cycle of operations are fully described. Hot vapours from the coke drum pass to a fractionating tower, naphtha passing overhead and gas oil suitable for cracking stock withdrawn from the base. The length of runs, approximately 900–1000 hrs. of continuous operation, is generally limited by coking within the furnace roof tubes and sometimes in the upper wall tubes.

Yields by weight obtained from the particular residuum are approximately 22·4% gasoline of A.S.T.M. octane number 55, F. B. pt. 400° F., Reid vapour pressure 8 lb.; 69·1% of gas oil, 4·5% gas, 12·4% coke. The coke produced differs somewhat throughout the drum, being more dense and containing less volatile matter in the lower section. Principal conditions controlling coke hardness appear to be: (1) furnace outlet temperature, (2) time coke remains at elevated temperature, (3) efficiency of drum insulation, (4) characteristics of residuum. Conditions can thus be adjusted by several means to produce the hardest coke consistent with ease of removal from the drum.
R. A. E.

151. (Atlantic Refining.) Operation Data for Sludge Conversion Contact Acid Plant. W. B. Hart. *World Petrol.*, Annual Ref. Issue, 1938, **9** (11), 117.—The usual method of recovery of acid from petroleum refining sludges by separation of sludge and con-

centration of acid leaves the problem of disposal of the residual sludge. A method has now been developed for the decomposition of the sludge with heated coke, the purification of the gases, combustion to remove any residual hydrocarbons (any H_2S available being added at this stage), and the conversion of the SO_2 formed to sulphuric acid by the contact process. Acids of 80% H_2SO_4 up to 20% fuming acids are produced, 89–90% of the original acid in the sludge being converted, whilst with H_2S a 94% conversion is obtained. The plant described has a capacity of 65 short tons of 100% acid per 24-hour day, 50 tons from sludge and 15 tons from H_2S, or 50 tons of 98% H_2SO_4 and 15 tons of 20% fuming acid. As by-products 13 tons of dry granular coke and 1300 gals. of recovered oil are obtained.

The decomposer consists of a revolving kiln in which the heated coke and sludge are introduced. Separate charging systems for naphtha and for heavier sludges are advisable, as separation of acid is liable to take place when the two are mixed. The temperature of the outlet coke is controlled at 500–550° F. The vapours from the decomposer are drawn off through a flue to an overhead spray scrubber 5 ft. in diameter and 18½ ft. high, where coke dust is removed, and thence to the spray cooling tower, to condense as much water and oil as possible. They then pass to the oil separator, the outlet temperature of which is controlled at not more than 90–92° F., in order to limit the amount of hydrocarbon vapour. The remaining hydrocarbons are removed in a horizontal cylindrical furnace operating at 1400–1800° F., into which any H_2S available is admitted. The gases leaving the furnace at about 1500° F. contain about 12% SO_2 and are cooled by a water-spray. Thence the gas passes into the contact acid system, consisting of Cottrell mist precipitator, 60° C. acid dry tower, blower, converters and absorbers. Operating details, plant organization and typical analyses of sludge are given. C. L. G.

152. Flexibility Characteristics of Recently Completed Manchester Refinery. Anon. *World Petrol.*, Annual Ref. Issue, 1938, **9** (11), 138.—Full details are given of the Manchester oil refinery plant at Manchester, which consists of a Foster Wheeler high-vacuum distillation unit of capacity 150,000 tons p.a., a combined solvent treating and dewaxing unit using benzol/SO_2 with a capacity of 40,000 tons p.a., a de Laval acid-treating plant and a contact clay-treating and filtration plant with an annual capacity of 60,000 tons, storage tanks of approximately 30,000 tons capacity, boiler plant and complete auxiliary equipment.

The distillation unit can handle heavy crudes or residuum, and is designed to produce kerosine, gas oil, three lubricating-oil fractions and a residue. The use of benzol and SO_2 permits wide variation in the selectivity of the solvent extraction, whilst separation of the two components is easily obtained. A 25 : 75 benzol/SO_2 mixture is usually employed, the relative positions of the raffinate and extract layers in the plant being ascertained by a neon-light system based on the different conductivity of the two liquids. The raffinate solution is diluted to give an 80 : 20 benzol/SO_2 mixture and passed to the dewaxing filters, the cooling being obtained by the evaporation and compression of SO_2 in a special cooling system. The refinery programme visualizes the production of 20,000 tons of solvent-extracted lubricating, transformer and white oils, and up to 35,000 tons of acid-treated lubricating oil, a total of 60,000 tons of kerosine, gas oil, diesel and fuel oils, axle oil, dark cylinder stock and 10,000–20,000 tons of bitumen. As by-products of the solvent plant there will be a production of 3000–5000 tons of paraffin waxes, and possibly a small production of petroleum jelly if required. C. L. G.

153. Houdry Processes for Catalytic Treating of Petroleum. E. Houdry, W. Burt, A. E. Pew and W. A. Peters. *World Petrol.*, Annual Ref. Issue, 1938, **9** (11), 68.—The processes described include: (1) catalytic cracking of crude or any fraction thereof (except gasoline) with or without the production of tar or heavy liquid products; (2) catalytic viscosity breaking; (3) catalytic treatment of gasoline from thermal or catalytic cracking; (3*a*) liquid phase catalytic treatment of aviation gasoline from catalytic cracking; (4) catalytic desulphurization of gas from cracking or topping operations; (5) catalytic polymerization in liquid phase of butenes; and (6) catalytic cracking of heavy gas oils or of residuums to lighter gas oils for furnace oil requirements.

1. In catalytic operations flexibility of design permits of a wide variety of stock being handled, including the direct cracking of the entire crude. In general, from

single pass operation on any stock is obtained a yield of 45% of gasoline of O.N. 77–81 for 437° E.P. gasoline, with high lead susceptibility and blending value. Catalytic gas oils are suitable for catalytic or thermal recracking. A typical flow sheet and details of yields from various stocks are given. A particular feature is the ability to produce 76–78 O.N. aviation gasoline, which can be brought to 87, 90 and 92 O.N. with 1·8, 3 or 4 mls. of tetraethyl lead per gallon, respectively. Seven million gallons are stated to have been made in 1937–38. A 100 O.N. (army method) blend marketed consisted of 25% *iso*-octane, 75% of Houdry aviation gasoline and 2·75 c.c. of lead. Typical properties of Houdry aviation gasolines are tabulated and also the properties and yields of products from the catalytic cracking of various gas oils. In the running of crude oils, non-residuum operation can be carried out by replacing the tar separator vaporizer by a director catalytic vaporizer in which the residual carbon is deposited on the catalyst and subsequently removed during regeneration by burning off. Yields from Mid-Continent crude bottoms, Lagunillas crude and West Texas (New Mexico) bottoms are tabulated, being 39·4–47·7% gasoline of O.N. 78·6–79·8, the remainder being gas oil without the production of heavy oils.

3. The catalytic treating operations described cover: (*a*) vapour-phase treatment of catalytic or thermal gasoline and (*b*) liquid-phase treatment of catalytic aviation gasoline.

The untreated catalytic gasoline is of low gum content (induction period of 10 hrs. or more), low sulphur, colours generally sufficiently good to enable dyeing, but will not pass doctor or corrosion test, although a caustic-soda wash enables it to pass the corrosion test. The treatment causes no loss of O.N., and yields a very low-gum, doctor sweet gasoline of high stability, low sulphur, excellent colour and odour. Operating costs vary from 2·5 to 4·5 cents per brl. The treatment consists of passing the vaporized gasoline at about 600° F. and 15–100 lb. pressure over moulded solid catalysts of acid-treated clays containing oxides of heavy metals, Mn and Ni.

4. Catalytic desulphurization is available for the almost complete removal of sulphur from refinery gases, the gas being heated to about 750° F. and passed over supported nickel for 30 mins. or more. Coke-oven gas containing 400 grains of H_2S and 45 of CS_2 was processed, removing 96·5% of CS_2 and reducing the H_2S to less than 1 grain per 100 cub. ft.

5. A selective liquid-phase catalytic polymerization process treats butenes yielding motor gasoline of A.P.I. gravity 57, O.N. 84–85 and blending value 136. Yields of 55–72% of unsaturateds are given in one pass, the polymer being an excellent base stock for hydrogenation to *iso*-octane.

2 and 6. Yields are also given of the viscosity breaking of residuals from West Texas and mixed coastal and East Texas crudes, yielding 1 and 2% of naphtha, and 3 and 5% of gas oil, respectively.

Regeneration of the catalysts in all processes is necessary, the activity decreasing owing to carbon deposits. Operating cycles vary from 30 to 135 mins. in cracking fuels and gas oils, from 8 to 12 hrs. in vapour-phase treating operations and from 6 to 12 hrs. in the polymerization operation. The life of the catalyst is unlimited, no reduction in yield being experienced over 12 months' operation. The catalyst cost for a plant charging 15,000 brls. daily amounts to $36.000.

The extreme flexibility of the operations and the higher yields of valuable products and the wide variety of stocks which can be treated are emphasized. C. L. G.

154. Cleaning Heat-Transfer Equipment. G. R. Hersam. *Petrol. Engr*, Nov. 1938, **10** (2), 71.—A discussion is presented of the main types of deposits formed in heat transfer equipment and of the more important cleaning methods and compounds in use. Deposits may be either oil residues—*e.g.*, sludge, carbon, salts, silt, etc.—or water and corrosion scales or rust, whilst slime and algæ may also be present. The deposits may be hard, porous or loose, the porous type being regarded as more serious owing to its lower conductivity. Drilling or rodding out is troublesome, and liable to cut thin walls of small heat-exchange equipment. Circulation of HCl to remove water and scale is liable to corrode equipment, but special inhibited acids are more efficient, and are not appreciably corrosive. Soft and loose deposits—*e.g.*, sludges and some oil residues—may be removed by blowing hot water or steam through the unit or by swabbing. Plastic plugs may be forced through the tubes, but are of no value for hard scales.

Modern methods consist of circulating specially selected cleaning compounds at nearly boiling point with violent agitation through the equipment, followed by flushing with steam or water. It may be preferable to remove tube bundles and immerse them in the solution. Completely plugged tubes must be rodded out first. It is recommended that there should be a permanent installation of cleaning equipment and that where possible spare sets of heat exchange, etc., equipment should be installed for use while one set is being cleaned. C. L. G.

155. Hydraulic Decoking of Coke Chambers. W. F. Court. *Oil Gas J.*, 18.11.38, **37** (27), 179.—A new method of removing coke from coke chambers now in commercial use consists of cutting the coke by means of high impact-producing water-jets.

The unit described is in operation at Wood River Refinery of Shell Petroleum Corporation in conjunction with a combination cracking and coking unit processing 16,500 brls. a day of topped crude, gas oil and pressure distillate and producing 7000 brls. of 70 octane gasoline and 300 tons of coke per day. The four coke chambers are used in a 48-hr. cycle, only one at a time being on stream. Each chamber is filled within 10 ft. of the top, equivalent to approximately 150 tons of coke, and two chambers are cleaned every day. The average length of run on the coking section of the plant is 30 days. Hydraulic cutting nozzles are attached to special tools mounted at the end of a hollow stem, to which water is supplied from a high-pressure header through a steel-piping linkage made flexible by ball-bearing swivel joints. This stem is suspended from an overhead structure mounted above the chamber, and is lowered and raised by means of an air hoist.

The operation involves two steps: (1) Boring a hole 18 in. in diameter downwards through the coke, which is accomplished by means of a special boring tool, in two sections, to save excessive height in the overhead structure; (2) cutting and removing the coke from the chamber. When the boring tool emerges from the bottom manway, it is replaced with a part of the assembly of cutting nozzles. It is elevated into the chamber in order to make an enlarged opening in the bottom of the coke-bed. The complete cutting assembly is then attached and raised into the chamber. In the first cutting operation the nozzles are offset to give rotation, and the jet of water issues horizontally, penetrating to the chamber wall. The complete assembly has two nozzles pointing slightly upwards at an angle, and serves to cut the coke away from the wall. As the coke is cut into layers by the revolving jets, it breaks away and falls to the bottom of the chamber, and into cars. The water draining falls on to a concrete floor, and the fine coke is washed into trenches, accumulated in a pit and pumped into partly filled cars in which the coke-bed retains the fines. The rate of flow of water to the cutting nozzles is approximately 700 gals. per min. under a pressure of 900–1000 lb. at the entrance of the nozzles. Considerable research was necessary to discover the best type of nozzle and optimum pumping rates and pressures. As a result it is possible to remove completely 150 tons of coke from a chamber and have it ready for heading up again in less than 2 hrs. Coke so hard as to present difficulties in removal by the cable method is easily removed by the hydraulic method. Advantages claimed over the cable method are: (1) clean-out time halved; (2) saving in labour; (3) saving in cost of cables, etc; (4) elimination of cable-fastening wire from coke produced; (5) complete coke removal from chamber wall; (6) elimination of hazard, since no clean-out crew is required to enter the chamber at any time. The cost of maintenance of jetting nozzles is low, and tests have indicated that the cutting action has no effect on the steel walls of the vessels. R. A. E.

156. Technical and Economical Aspects of the Thylox Process. W. Fitz. *Brennst-Chemie*, 1.11.38, **19** (21), 397–402.—The development of the Thylox process operating in one stage with clear solutions, and yielding elementary sulphur, is described. The process is at present used in twenty-one plants with a total yearly output of almost 120 milliard cub. ft. of gas. Two Japanese Thylox plants are described, and the results obtained are given. One of these two plants is used for the purification of coal distillation gas diluted with water gas, whilst in the other plant blue water gas is freed from hydrogen sulphide. It is of special interest that the hydrogen sulphide content of blue water gas is reduced, solely through the application of the Thylox process, to 1·45 mgr. per cub. metre, which is far below the allowable maximum of 20 mgr. per cub. metre.

The economy of the Thylox process is discussed, based on data from various plants, and operating cost are plotted against hydrogen sulphide contents for varying gas output in the case of coke-oven gas and water gas, respectively. In the purification of great quantities of coke-oven gas in certain cases a net operating credit results. By virtue of its great economic and operating advantages, together with the efficient elimination of hydrogen sulphide, it is likely that the Thylox process will be introduced in Germany for the purification of water gas and of the gaseous hydrocarbons for oil synthesis. L. R.

157. Alloy Steel Valves for Sub-Zero Temperatures. G. F. Scherer. *Industr. Engng Chem.*, 1938, **30** (11), 1220.—Although the tensile strength, yield point, modulus of elasticity and hardness change favourably with decrease in temperature, the shock resistance is affected adversely with a decline in temperature. High nickel–copper alloys and austenitic chrome–nickel–iron alloys are the best metals known to possess high impact resistance at sub-zero temperatures. Specifications are given for material suitable for working temperatures down to − 150° F. at a pressure of 600 lb. per sq. in. J. W. H.

158. Centrifugal Pumps for the Process Industries. H. E. LaBour. *Industr. Engng Chem.*, 1938, **30** (10), 1105.—The history and performance characteristics of centrifugal pumps are given briefly. There is available a wide range of materials from which pumps may be constructed, and these are considered in some detail in relation to the duty of the pump. Slight constructional modifications are advantageous in many cases, and these are also discussed. P. D.

159. Plate and Frame Filter Press. P. Kriegel. *Industr. Engng Chem.*, 1938, **30** (11), 1211.—The advances in the design of filter presses to meet specific process requirements are reviewed. These advances include special corrosion-resisting materials of construction and gusketed plates and frames capable of operating at pressures up to 1000 lb. per sq. in. Typical installation and operating cost data are given for the recovery of filter cake from a chromium hydroxide slurry and for the clarification of cider. J. W. H.

160. Patent on Refinery Plant. K. Koppers. U.S.P. 2,137,722, 22.11.38. Distillation apparatus for the distillation of high-boiling liquids such as coal-tar at decreased pressure. W. S. E. C.

Chemistry and Physics of Petroleum.

161. Application of Catalysts in Organic Chemical Industry. G. Natta. *Chim. e Industria*, November 1938, **17**, 719–724.—The development of catalysts in recent years is outlined and the principal applications in industry are examined. Particular attention is given to catalytic hydrogenation and dehydrogenation. The application of catalysts in the hydrogenation of mineral oils and residuals is mentioned, as well as the processes used: liquid phase with suspended catalyst and liquid phase with fixed catalyst for products boiling under 400° C. Interesting is the fact that by appropriately varying the operating conditions it is possible to obtain from certain raw materials either products mainly consisting of normal paraffin hydrocarbons, or branch-chain hydrocarbons, or naphthenic hydrocarbons. The hydrogenation of the double-bond hydrocarbons is at present very simple, being obtained at low temperatures, whilst the yields are good (the hydrogenation of the *iso*-octene to *iso*-octane takes place at normal temperature). The catalytic hydrogenation process, besides being used for preparation of glycerine from hydrocarbons, is employed in the synthetic rubber industry, where it represents one of the most important intermediate steps (transformation of the aldol in butylene glycol): this reaction, taking place at very low temperatures, necessitates a very active catalyst. The catalyst reactions of dehydrogenation are mentioned, and those employed for the synthesis of rubber (Buna S) for passing from butylene to butadiene, and from ethylbenzene to styrene, are pointed out. Also the dehydrogenation of alcohols has found application

in Italy—for instance, in the preparation of acetone from *iso*propyl alcohol. Good results have been obtained employing catalysts of the alumina and kaolin type for the hydration and dehydration reactions. From the first industrial process of this type synthesis of acetaldehyde from acetylene in presence of mercury oxide, it was found possible to prepare in this way *iso*propyl ether suitable for the preparation of aviation fuels. Serious difficulties have been encountered in effecting the catalytic reactions of oxidation, on account of the disadvantages resulting from the high reaction heat. In this connection are mentioned the oxidation of ammonia, of aldehyde into acetic acid, the catalytic oxidation of benzene to phenol, and the oxidation of aliphatic hydrocarbons to fatty acids. The condensating and polymerizing action of catalysts is then examined; the preparation of *iso*-octane from *iso*-butylene is mentioned, and the procedure for the preparation of synthetic rubber Buna S is illustrated. This process consists of different phases: hydration of acetylene and acetic acid, condensation of aldol, reduction of aldol to glycol, dehydration of glycol to butadiene and polymerization of butadiene. The various functions of the catalysts and their application in an extensive branch of industry are set forth. Some suggestions as to the inherent mechanism of these reactions and on the characteristics of the catalysts employed are given. Stable, resistant and very active catalysts must be available, and, owing to the high investment cost of equipment, it is necessary to reduce the volume of catalysts to the minimum in order to have maximum throughput. In plant operation, where catalysts are used under temperatures close to the melting point, it is necessary to use small amounts of inert substances, so-called promoters, which prevent undesirable re-crystallization. The active surface should be porous, but not to a too great extent—about 40–50% of the volume—since otherwise the mechanical resistance would be impaired; its action should be the surface absorption of the reacting gases. A. R.

162. Infra-Red Absorption Spectra of Some Naphthalene Hydrocarbons. P. Lambert and J. Lecomte. *Ann. Off. Combust. Liq.*, 1938, **13**, 111–126.—The authors have examined the infra-red absorption spectra of the following hydrocarbons:—

α- and β-benzylnaphthalene, 1 : 4- and 1 : 8-dibenzylnaphthalene, indene and *iso*-butylindene.

The results are given in the form of curves showing the amount of light transmitted, plotted against the wave-length. A fact which the measurements have shown is the importance of the region from 15 to 20 μ in the identification of hydrocarbons. The various maximum regions of absorption for the hydrocarbons examined are given in tabular form.

The paper discusses the effect of the constitution of the hydrocarbons on the type of spectrum obtained. W. E. J. B.

163. Fractionation of Mineral Oils by Gas-Saturated Propane. M. Godlewicz. *Petrol. Z.*, 13.7.38, **34** (28), 1–12.—This paper describes the use of gas solutions for fractionating heavy hydrocarbon mixtures. The mineral oil is dissolved in a solvent such as propane, which is then treated with a gas—*e.g.*, methane—under pressure. The gas dissolves and two liquid layers are formed. Stepwise fractionation can be obtained by using gas at various pressures.

In an example given, a crude oil residuum was dissolved in propane and the resulting asphaltic residue drawn off. The remaining solution was saturated with gas to a pressure sufficient to cause the separation of a dark constituent. This was drawn off and further saturation carried on, resulting in a series of oil fractionates.

The author compares the effect of cold fractionation with fractional distillation. In the case cited, the fractionates had lower specific gravities and viscosity indexes over 50 units higher than the distillates. An asphalt from a commercial pipe still when treated by this method yielded 14% of a valuable oil.

Natural gas under pressure applied to the cresol–propane extraction system increased the selectivity of the process. When oil dissolved in propane was fractionated by CH_4 in the presence of cresol, the first separation was the cresol phase containing dark-coloured substances.

As the CH_4 pressure was increased to above 40 atm., fractional separation occurred, and under some conditions three immiscible layers were formed. By adding water to the 3-phase system four immiscible layers have been formed, and it is said to be

possible to obtain five immiscible layers in equilibrium by using a solution of ammonia saturated K_2CO_3. D. L. S.

164. Oxidation of Naphthene-Base Oils by Oxygen. K. I. Iwanow. *Petrol. Z.*, 1938, **34** (32), 1.—The relative oxidizability of paraffin and naphthene base oils, respectively, was studied in connection with the production of commercial acids from petroleum, and with special reference to the effect of degree of refining prior to oxidation.

Gas oils of the two types were oxidized in a steel bomb heated to 150° C. for 3 hrs. and containing O_2 at 15 atm. Technique of separating unsaponifiable material, fatty acids and oxy-acids is described in detail. Saponification and acid values and iodine value were determined on each type of oxidation product. These methods were applied: (*a*) to crude distillate and (*b*) to oils after refining with progressively increasing amounts of sulphuric acid, and finally oleum. A standardized method of refining and washing was adhered to.

It was found that:—

(1) In both types of oil a minimum oxidizability was obtained when about 3% acid was used for refining. This behaviour was attributed to the difficulty of washing out oxidized products after the first acid treatment, these products remaining in the oil as negative oxidation catalysts. Larger amounts of acid destroyed these compounds. With more than 3% acid refining, yield of oxidized products was proportional to degree of refining in both types of oil.

(2) Washing with soda (after acid treatment as opposed to water washing) had practically no effect on oxidizability.

(3) Carboxylic acids formed the chief product of reaction, especially in the more drastically refined samples.

(4) When oxidizability and yield of fatty acids were about the same, less oxy-acids were formed in paraffin base oil than in naphthenic oil. P. G. H.

165. Synthesis of Acetylene. F. Fischer and H. Pichler. *BrennstChemie*, 15.10.38, **19** (20), 377–380.—If an electric arc is burning between two carbon electrodes in a hydrogen atmosphere within a vessel not specially cooled, some percentage of hydrogen is transformed into acetylene and hydrocarbons of high hydrogen content. By cooling the reaction vessel with liquid air, the acetylene formed is frozen out and secondary reactions are inhibited. By this means all hydrogen can be transformed into acetylene and, to a certain extent, into hydrocarbons rich in hydrogen. The reaction velocity depends on the type of electric arc. It is practically independent of pressure, and slows down only at low pressures. In a test, 99·9% of the hydrogen was transformed in 9 min., with a corresponding fall in pressure from 8·8 to 0·007 mm. Hg. There is less tendency to form secondary products of high hydrogen content at low than at high pressures. This is explained as follows: (*a*) hydrogenation reactions are independent of pressure, and (*b*) with falling pressure, the probability that a newly formed acetylene molecule, on its way to the wall, may collide with a reactive hydrogen molecule is decreased. Moreover, at the temperature of liquid air, acetylene has the lowest vapour pressure of all hydrocarbons likely to be formed. When using hydrogen-free methane under similar conditions of test, pressure fell within 18 min. from 8 to 0·1 mm. Hg.

Constant-pressure tests were carried out supplying hydrogen through a quartz tube. By this means larger quantities of acetylene could be precipitated on the walls of the reaction vessel. Separation of acetylene from the other hydrocarbons formed is best carried out by pumping out the latter at low temperatures. L. R.

166. Accurate Fractionation of Hydrocarbon Blends. H. Macura and H. Grosse-Oetringhaus. *BrennstChemie*, 1.12.38, **19** (23), 437–439.—The apparatus used consists of a round-bottomed flask of 500 c.c. capacity connected by ground joint to a vertical cylindrical glass tube of 700 mm. height and 24 mm. diameter, with seventeen restrictions to 18–20 mm. diameter for interruption of the reflux current. The lower portion of the column carries a funnel with two openings, and in the top a dephlegmator and a thermometer are inserted. The vapours pass through a vertical cooling coil which condenses the distillate, after which it is collected in graduated receivers. The column is surrounded by a vacuum jacket to prevent heat losses. It is filled with spirals made of 0·5 mm. aluminium wire.

200 c.c. of oil are used for each test or, if contents below 5% have to be determined, 400 c.c. To hydrocarbon blends distilling up to 140° C., 200 c.c. decaline are added, whereas those distilling up to 160° C. are blended with tetraline. Still higher boiling blends are mixed with anthracene or paraffin oil. By this means distillation can be carried out to 95–98%.

Graphs are obtained by plotting temperatures against percentage distilled at 1% intervals. The contents of a certain fraction are found by determining the difference in percentage between the respective points of inflection. L. R.

167. Applications of Dühring's Rule. E. J. Roehl. *Industr. Engng Chem.*, 1938, **30** (11), 1320.—The Dühring lines for a set of solutions of a given substance form a family of straight lines, each one of which may be characterized by an intercept and a slope. It is shown that logarithmic equations may be used to connect concentration and slope, or concentration and intercept in the case of solutions of sodium chlorate and sodium bromide. If this method of connecting concentration and slope or intercept is generally valid, it is possible to construct a set of Dühring lines for a complete range of concentrations from two measurements on each of two solutions.

Similar equations may be used to connect number of carbon atoms in a homologous series with intercept and slope. This is applied to the paraffin series from propane to nonadecane. P. D.

168. Separation Processes : Analysis of Unit Sections. M. Randall and B. Longtin. *Industr. Engng Chem.*, 1938, **30** (10), 1188.—The basis of the graphical method of representing separation processes has been previously discussed (*Ind. Eng. Chem.*, 1938, **30**, 1063). The method is applied to various parts of distillation and solvent extraction equipment. As applied to a perfect plate it becomes the well-known method of Ponchon. The authors show how the Murphree efficiency and effect of entrainment may be allowed for. Solvent extraction processes may be similarly dealt with by regarding addition of solvent to be equivalent to addition of heat. Other typical equilibrium processes, such as condensers and vaporizers, are also considered. P. D.

169. Separation Processes. M. Randall and B. Longtin. *Industr. Engng Chem.*, 1938, **30** (11), 1311.—Previous papers by the authors have discussed the application of molal property *v.* mole fraction diagrams in representing such processes as distillation or solvent extraction. They are not, however, always as convenient to work with as the x *v.* y diagram, and the present paper gives rules and examples of the transformation of one type into the other. P. D.

170. Phase Equilibria in Hydrocarbon Systems. B. H. Sage and W. N. Lacey. *Industr. Engng Chem.*, 1938, **30** (11), 1296.—The equilibrium constants for methane have been reported for several hydrocarbon systems. In this paper the published data are reviewed and correlated as a function of pressure, temperature, and molecular weight and viscosity–gravity constant of the other constituents. P. D.

Analysis and Testing.

171. Review of Test Methods for Insulating Oils—The Italian Method. D. Rossetti. *Olii Min.*, 1938, **18** (10), 137–143.—Among the main characteristics which a transformer oil or an electric switch oil has to meet, the tendency of the oil to alteration by effect of temperature and oxidizing action of the air is the most interesting. It is therefore very important to fix by severe and strict specifications a method which permits with sufficient accuracy the reproduction in the laboratory of actual conditions of use.

This method, set forth in its main details in 1924 by the "Regulations for Supply and Control for Transformer Oils and Electric Equipment Oils," was subsequently elaborated to the present method (300-hrs. life test at 110° C. in presence of copper + "Italian Regulations for the Control of Mineral Oils and By-products," second edition, 1928). The results of numerous tests carried out on the same oil in different thermostats of the same type (Heræus) are reported, together with results obtained on identical samples in the same thermostat. An attempt is made to explain the differences found, first with the construction of the thermostats, which, though of the same supplier, are not identical; and then by the fact that the inside temperature is not

equal at all points, because of air draughts circulating in the thermostat. The results of extensive test work demonstrated that while an oil sample placed near the back wall of the thermostat showed after the 300-hrs. life test about 0·45% of sludge deposit and about 0·22% acidity, a sample of the same oil placed near the door of the apparatus showed only 0·35% of sludge deposit and 0·18% acidity. It is concluded, therefore, that given the higher temperature near the back wall, the formation of deposits and acidity is influenced to a greater extent by temperature than by the oxidizing action of the air filtering through the door fissures. In consideration of these factors which affect the results of the life test, it is proposed to use a thermostat of more careful construction, and to adopt a rotating support for eight test-tubes, doing about one revolution per minute, which should be placed inside the thermostat. It is stated that tests carried out with the above-mentioned procedure gave more constant results, showing sensibly lower disparities. Finally, some modifications and closer specifications of the procedure for the official 300-hrs. method are suggested by the author.

P. G.

172. Determining the Sediment Content of Fuel Oil. S. H. Hulse and H. L. Thwaites. *Industr. Engng Chem.* (*Anal.*), 1938, **10** (12), 678–680.—No test at present in general use can be employed satisfactorily to indicate the tendency of fuel oils to deposit sludge on storage, or to predict the fuel's stability in contact with preheater surfaces, especially in the case of fuels containing cracked residues. The "sediment by extraction" test is often applied, and does give some indication of storage properties, but is valueless as a guide to stability to heat. The authors' method involves filtering undiluted oil through an asbestos mat in a special steam-jacketed filter funnel, washing the residue free of oil with a high fl. pt. paraffinic naphtha ("Stoddart solvent"), drying and weighing.

The sediment in cracked residues consists partly of small primary particles held together by an asphaltic binder, and partly of solid asphaltic matter, insoluble in oil. The benzene used in the extraction test will dissolve this asphaltic matter and disperse the primary particles, thus giving a totally fictitious idea of the sediment content of the fuel. The new method simulates service conditions which involve heating the fuel, but not thinning it with an aromatic solvent.

The authors quote figures to show that the test is of good reproducibility, the average deviation of eleven laboratories being $\pm$ 0·025 in a sediment number of about 0·2, most of which is probably due to the difficulty in getting a truly representative sample.

T. T. D.

173. Iodine Value of Hydrocarbons. H. Grosse-Oetringhaus. *BrennstChemie*, 15.11.38, **19** (22), 417–427.—Based on numerous tests carried out on a variety of oils and gasolines, the merits of the various methods of determining the iodine value are investigated.

In the case of gasolines, the method given by Wijs can only rarely be applied, owing to the great tendency to substitution. The method according to Hanus gives better results. Both methods fail in the case of mineral lubricating oils, but are suitable for highly compounded oils. The iodine values, according to Margosches, are in most cases too low. The lack of a suitable solvent makes application to lubricating oils impossible, except when they are highly compounded.

Kaufmann's method of determining the iodine value of gasolines is considered to be preferable to all other methods, especially in the case of gasolines of high iodine number, if carbon tetrachloride is used as a solvent (reaction time 7–8 hrs.). With lubricating oils only approximate values are obtained.

The method suggested by McIlhiney cannot be applied to mineral oils, no matter what halogen is used. Rhodan (thiocyanogen) values and iodine–rhodan values of gasolines are slightly below iodine values according to Kaufmann. With lubricating oils greater deviations are obtained. The partial iodine value is always considerably lower, and there is no correlation with the thiocyanogen value.

A new method of test is presented—the so-called "iodochloride number"—which is obtained by making use of iodochloride dissolved in methyl alcohol saturated with calcium chloride.

Sources of error and practical applications of the iodine number are given. L. R.

174. Viscosity of Petroleum Emulsions. L. T. Monson. *Industr. Engng Chem.*, 1938, **30** (11), 1287.—Viscosity ratios were measured for twenty water-in-oil emulsions at temperatures of 100°, 130° and 185° F. Five crude oils were used, and emulsions containing 10, 20, 30 and 40% of water were made from each crude. P. D.

175. New Catalyst for the Determination of Nitrogen by the Kjeldahl Method. R. B. Bradstreet. *Industr. Engng Chem.* (*Anal.*), 1938, **10** (12), 696.—A mixture of equal parts of ferrous sulphate and selenium is suggested as a catalyst for Kjeldahl nitrogen determinations.

Using sulphuric–salicylic acids as digestion medium, figures are given to show the new catalyst to be at least as good as the copper sulphate–selenium mixture.

T. T. D.

176. Determination of Sulphur in Surface-Active Agents. R. Hart. *Industr. Engng Chem.* (*Anal.*), 1938, **10** (12), 688–689.—The methods available for the determination of organically combined SO_3 in detergents or wetting-out agents are: (*a*) the Herbig method, (*b*) the acid-titration method, and (*c*) the ash-gravimetric method, in which the pure sulphonated product is isolated by extracting over concentrated NaCl solution and ashed. The first two methods are of use only in the case of sulphuric acid esters, as true sulphonates are not decomposed under the conditions of the methods. Method (*c*) overcomes this difficulty, but in the case of highly sulphated oils, the sulphonated alcohols and sulphonated fatty acid amides, the extract carries over with it, in solution, a large amount of salt which vitiates the results.

The new method applies to all compounds that can be quantitatively extracted with a solvent over concentrated NaCl solution. The sample, in a suitable solvent, is shaken repeatedly with NH_4Cl solution until it is quantitatively converted into the ammonium salt—about five operations. The solvent layer is then similarly shaken with concentrated Na_2SO_4 solution; all the ammonia bound to the organically combined sulphate or sulphonate is converted into $(NH_4)_2SO_4$, and passes to the water layer, together with any NH_4Cl with which the solvent layer may have been contaminated. The water layer is now analysed for total ammonia, and for ammonia as ammonium chloride. The difference represents the ammonia bound by the organic compound, from which the organically bound SO_3 may be readily calculated.

In cases where they are both applicable, good agreement is obtained between the new method and the ash-gravimetric method. T. T. D.

Motor Fuels.

177. Anti-Knocking Motor Fuels. M. Marder. *Oel u. Kohle*, 1938, **14**, 697.—A comprehensive survey of available methods for producing fuels of high octane number by solvent extraction, hydrogenation, dehydrogenation, alkylization, cyclization, etc.

The principles underlying each method are described briefly and extensive references are given. The properties and application of the various high octane fuels are outlined. P. G. H.

178. Patents on Motor Spirit. G. W. Johnson. E.P. 495,889, 22.11.38. Production of motor spirit from gases containing methane homologues which are gaseous at ordinary temperatures. Olefines are first separated, the remainder containing CH_4 homologues is subjected to splitting and the mixture of olefines and split gas polymerized at 350° C. and above 20 atm., in a vessel constructed partly of silicon or of a highly alloyed chromium steel.

Universal Oil Products Co. E.P. 496,273, 25.11.38. Alkylation of *iso*butane and a normally gaseous olefine containing more than C atoms in the molecule, in the presence of aluminium chloride and hydrogen chloride at −50 to 0° C., for the production of high anti-knock motor fuel.

P. Ostergaard. U.S.P. 2,134,836, 1.11.38. Vapour feed condenser and stabilizer for recovering stabilized motor fuel from a vapour mixture containing vapours of normally liquid gasoline components in admixture with vapours of low-boiling hydrocarbons and fixed gases.

D. A. Monro. U.S.P. 2,134,882, 1.11.38. Fractionating apparatus and process for gasolines.

A. L. Lyman and M. M. Holm. U.S.P. 2,135,823, 8.11.38. *iso*-Octane production (octane number above 80), from a normally gaseous hydrocarbon mixture containing olefines consisting substantially of isomeric butenes, by subjecting the mixture to the action of a phosphoric acid catalyst adsorbed on a non-porous, inert solid support at 100–400° F. to effect mixed polymerization of normal butenes and *iso*butene. The polymer liquid is separated from the unpolymerized substances and saturated by dehydrogenation.

E. J. Houdry. U.S.P. 2,136,382, 15.11.38. Catalytic conversion and stabilization of hydrocarbons containing gasoline by contacting, in a desulphurizing zone, with an inert absorbent material impregnated with an active metalliferous material from the group Ni, Co, Cu at 550–750° F. and then passing the hydrocarbon into a refining zone using as catalyst alumina and silica blend and a small quantity of Ni, Co or Cu at 400° F.

P. H. Sullivan. U.S.P. 2,137,825, 22.11.38. Production of motor spirit from normally gaseous hydrocarbons containing CH_4, C_2H_6, C_3H_8, C_4H_{10}, and C_5H_{12}.

P. M. Raigorodsky. U.S.P. 2,138,218, 29.11.38. Method of recovering useful hydrocarbons from gaseous substances—*e.g.*, natural gas, etc.—by an improved rectification process.

W. L. Benedict. U.S.P. 2,138,566, 29.11.38. Removal of copper compounds from copper-sweetened hydrocarbon oils by treating the oil with a double sulphide of Zn and Na in a solid form. W. S. E. C.

See also Abstract No. 179.

Gas, Diesel and Fuel Oils.

179. Proposed Method of Test for Ignition Quality of Diesel Fuels. Anon. *J. Soc. aut. Engrs*, **43**, 1938, 453.—The method of test described has been developed by the Automotive Diesel Fuels Division of the Co-operative Fuels Research Committee, and is published for purposes of general information, comments being invited.

The engine specified is the C.F.R. diesel with variable compression. Full details are given of the engine specification and conditions of test. A description of the "coincident flash" apparatus, together with instructions for its operation, are included. C. H. S.

Lubricants and Lubrication.

180. Recent Physico-Chemical Views on Bearing Lubrication. Burstin. *Petrol. Z.*, 8.6.38, **34** (23), 1–9.—Our knowledge of the mechanical aspect of lubrication has made great progress, but the physico-chemical aspects are only now engaging attention.

The author describes conditions that occur in commercial lubrication ranging from the fluid friction of ordinary bearings to boundary conditions in hypoid gears and the like.

In the latter case it is important that the lubricant should possess good film-forming properties.

The author describes three types of forces which are active in the boundary layer and which arise from the mutual attraction of molecules. These are :—

(1) The induction effect, which depends on the displacement of the electric charges leading to the formation of an electric moment.

(2) The dipole effect, caused by the arrangement of the molecules in a definite direction due to the attractive forces of the polar groups.

(3) The dispersion effect, depending on the effect of electron movement within the atom.

Three types of addition compounds are used to give oils the requisite film-forming properties :—

(*a*) Those with carboxyl or ester groups.
(*b*) Compounds of Cl_2, S and P.
(*c*) Metal compounds, chiefly those of Pb, Cr, Zn and As.

A survey is made of the methods available for testing such oils. Amongst those described are the "ferrum reductum" test of Irauth and Neyman, the S.A.E. and Timken machines, the Thoma and Spindel testers, and the instruments designed by Kyropoulos, Redgrove and Ralston, Hoffman and Stephens.

Finally the "Friktometer" of Wilder is described in detail and the method of using it to determine the static friction is discussed. D. L. S.

181. Viscosity Measurement on Lubricating Oils Below 0° C. K. Schwaiger. *Petrol. Z.*, 1938, **34** (45), 1.—A new type of viscometer to deal with oils at 0° C. to − 5° C. is described. An inner cylinder, capable of rotation, is fitted into another cylinder. The bearing surfaces (0·05 mm. clearance) are wetted with the oil under test. The inner cylinder may be rotated by a fixed weight and pulley system. The whole apparatus is cooled in a chamber which forms part of a refrigerator. The time for one half revolution of the inner cylinder is multiplied by a factor which gives dynamic viscosity in centipoises directly.

Viscosities and pole-heights obtained by extrapolation of values determined by normal methods at higher temperatures deviated from those obtained by the new viscometer. This is stated to show that the Walther relationship is inapplicable at low temperatures. Values obtained by the author's "practical" method and by Vogel–Ossag method respectively on five oils of very low setting point differed considerably in the case of three of the oils below 0° C.

The energy consumed by a starter motor in turning an actual engine at low temperatures was measured and the viscosity of lubricating oil in the engine cylinders was calculated. The viscosity curves for several oils obtained by the motor method were closely parallel to those given by the author's viscometer. P. G. H.

182. Oxidation of Roumanian Lubricating Oils. C. Candea and C. Manughevici. *Petrol. Z.*, 1938, **34** (49), 4.—Roumanian oils were oxidized with air in the presence of 0·02% of various inhibitors (thymol, *p*-toluidine, naphthylamine, α-naphthol, hydroquinine, phloroglucinol and resorcinol). Tests were carried out at 100° C., 200° C. and 300° C.; peroxide no. (Yule and Wilson), acid value and saponification value were determined after oxidation. Peroxide formation, which is regarded as the first stage of oxidation, occurred most readily at 200° C., but in all cases was lessened by the inhibitors. Development of acidity was also retarded by the inhibitors. In most of the tests, saponification value was reduced by the inhibitors at 200° C., but not at 100° or 300° C.

Thymol was the most effective inhibitor at 200° C.; its optimum concentration being 0·4% at 300° C., however, the maximum effect was obtained with 0·2% thymol. P. G. H.

183. Colloidochemical Basis of Greases. E. H. Kadmer. *Petrol. Z.*, 8.6.38, **34** (23), 2–4 (Suppl.); 13.7.38, **34** (28), 2–4 (Suppl.).—Emulsifying agents like soda soaps which lower the surface tension of water more than oil result in oil-in-water emulsions, whilst soaps such as those of lime and aluminium which lower the surface tension of oil more than water form water-in-oil emulsions. Thus lime base greases are of the water-in-oil type, whilst soda base greases belong to the reverse type. The author reviews briefly the commercial methods of manufacture of Na, Ca, Al and Pb greases.

The stability of lime-base greases can be improved by increasing the viscosity of the oil base and by using a proportion of neutral fat with the fatty acids. In the case of soda greases, the sponge type possesses a structure very difficult to modify by mechanical means. The dropping point of a soda soap lies between 230° and 270° C., and that of the grease prepared from it depends on the quantity of soap it contains, the nature of the fat from which the soap was made, etc.

Commercial aluminium greases, according to the author, cannot be made from an aluminium soap alone. Additions are recommended, and three are mentioned in this paper : (*a*) wax (Montan, wool, etc.), (*b*) crepe rubber, (*c*) rubber latex.

There is an urgent need for a water-resisting grease with a drop point of 120–130° C., and the author suggests that mixed Na and Ca base greases which are sometimes used for this purpose are not always successful. He suggests the use of mixed Na and Al base products, since these are both more or less water free. D. L. S.

184. Patents on Lubricating Oil and Wax. T. N. Montgomery and I.C.I., Ltd. E.P. 495,410, 14.11.38. Stabilization of chlorinated paraffin wax by adding 0·5–1% of a hydrocarbon of the pinene or terpene group or mixtures of these.

Robinson Bindley Processes, Ltd., and W. W. Myddleton. E.P. 495,575, 16.11.38. Catalytic synthesis of hydrocarbon oils from CO and H_2 in which the catalyst is used in porous spaces form and arranged between two concentric cylindrical surfaces. The rate at which the gases are passed over the catalyst is also specially controlled.

Standard Oil Development Co. E.P. 495,869, 18.11.38. Oxidation inhibitor for mineral lubricating oils consisting of 0·4% by weight of di-(4-tertiary butyl-6-hydroxyphenyl)thioether and 0·2% by weight of triphenyl bismuth or a mixture of 0·4% by weight of di-(4-tertiary butyl-6-hydroxyphenyl)thioether and 0·2% by weight of triphenyl tin iodide.

Metallgesellschaft, A.-G. E.P. 495,949, 22.11.38. Distillation apparatus for high-boiling liquids.

Colgate–Palmolive–Peet Co. E.P. 496,175, 25.11.38. Distillation apparatus for high-boiling liquids—*e.g.*, fatty acids.

W. G. Hiatt. U.S.P. 2,134,824, 1.11.38. Desulphurizing of petroleum oils by separating the vapours boiling between 600 and 800° F. and treating them with an inert gas heated to this temperature, and passing the diluted vapours in contact with a catalyst of the clay type.

M. Landau. U.S.P. 2,135,009, 1.11.38. Process of separating hydrocarbon mixtures into fractions using benzine as an extraction agent.

R. de M. Traveau, L. A. Clarke and R. E. Manley. U.S.P. 2,135,363, 1.11.38. Deasphalting of hydrocarbon oils using *iso*propyl alcohol, butyl alcohol and furfural.

G. H. Morley. U.S.P. 2,135,468, 1.11.38. Solvent refining of hydrocarbon oils using nitro-alcohols—*e.g.*, 3-nitro-4-heptanol.

E. Terres, J. Moos and H. Ramser. U.S.P. 2,135,922, 8.11.38. Dewaxing of lubricating oil using sulphuric oxyfluoride and an auxiliary solvent—*e.g.*, benzol.

R. C. Powell. U.S.P. 2,136,172, 8.11.38. Vacuum distillation apparatus for lubricating oils.

H. R. Dickinson. U.S.P. 2,136,282, 8.11.38. Process of imparting amorphous characteristics to normally crystalline waxes.

E. Terres, J. Moos and H. Ramser. U.S.P. 2,136,767, 15.11.38. Dewaxing of lubricating oils using an aromatic fluorine compound and benzol as auxiliary solvent.

F. X. Govers. U.S.P. 2,137,206, 15.11.38. Solvent refining of hydrocarbon oils using methyl furfural.

J. H. Grahame and W. L. Douthett. U.S.P. 2,137,207, 15.11.38. Dewaxing and deasphalting of hydrocarbon oils using propane at 80–100° F.

H. H. Gross and W. Kierstead, Jr. U.S.P. 2,137,208, 15.11.38. Dewaxing of hydrocarbon oils using a mixture of 40% of methyl ethyl ketone and 60% of benzol at 160–170° F.

E. C. Knowles. U.S.P. 2,137,209, 15.11.38. Dewaxing hydrocarbon oil in which the oil and wax are mixed with a selective solvent—*e.g.*, acetone and benzol.

F. X. Govers. U.S.P. 2,137,218, 15.11.38. Dewaxing of lubricating oil using a mixture of SO_2 and methylene chloride.

R. Z. Moravec. U.S.P. 2,137,499, 22.11.38. Solvent extraction of hydrocarbon oil by contacting the oil with a tertiary aliphatic alcohol and methyl ethyl ketone under conditions causing the formation of two liquid phases containing alcohol, ketone and different portions of the oil.

P. Subkow. U.S.P. 2,137,549, 22.11.38. Dewaxing of hydrocarbon oils using trichlorethylene, SO_2 benzol, CCl_4, etc.

A. W. Hixson and R. Miller. U.S.P. 2,138,166, 29.11.38. Solvent refining of hydrocarbon oils using chloronitropropane or chloronitrobutane.

E. Saegbarth. U.S.P. 2,138,772, 29.11.38. Refining of lubricating oils using *p*-monochlorphenol in the presence of propane as diluent.

E Terres, J. Moos and E. Saegbarth. U.S.P. 2,138,773, 29.11.38. Solvent extraction of lubricating oil using benzol and acetone at 108° F.

C. C. Towne. U.S.P. 2,138,775, 29.11.38. Preparation of synthetic lubricating oil by condensing a mixture of 8 parts by weight of propylene chloride and 10–12 parts by weight of benzene in the presence of 1–2 parts by weight of aluminium chloride at temperatures below 60° C. W. S. E. C.

Asphalt and Bitumen.

185. Compressibility and Ductility of Filled Road Tars. Anon. *Asph. u. Teer*, 1938, **38** (47), 800–806.—This paper describes investigations in which the effect of ageing and the incorporation of various fillers on rate of evaporation, compressibility and ductility of road tars and the relative wetting power of the tar for the fillers was examined. Rate of evaporation was determined at various temperatures and times by estimating loss in weight of films of tar 0·15 mm. thick on glass plates. For the wetting power a drop of the tar was allowed to fall from a Ubbelohde drop-point apparatus on to the filler, which was placed on a glass plate suspended in water at 55° C., the area of the drop of tar then being determined after cooling. Compressibility was determined by measuring the decrease in height at various temperatures, under a weight of 10 gms., of specimens 50 mm. high and 10 mm. in diameter. In the ductility test one end of the usual mould is fastened to the movable carriage and the other to a cord attached to a weighted lever. The two latter tests are considered more suitable for examination of the effect of ageing and filler than the method proposed by Sabrou and Renaudie. A. O.

186. Viscosity and Cohesion of Bituminous Binder in Relation to Temperature. G. Zichner. *Asph. u. Teer*, 1938, **38** (49), 835–841.—It is pointed out that in the investigation of physical-mechanical properties of binder-aggregate mixtures, conditions must be so controlled that only the binders differ. The object of the investigation described was to examine the relation between viscosity and cohesion. The various commercial methods of determining viscosity of bituminous binders were considered unsuitable, and the Couette apparatus was first employed in the investigation, but was unsuitable for determinations at high temperatures, and the Höppler falling sphere viscometer was eventually used. Results for a number of binders indicated that a straight line was given when the viscosities divided by a constant were plotted on the log log viscosity–log absolute temperature system, the constant for road tar being 2·0 and for bitumen 1·75. It is not known whether these constants hold for all materials. It is suggested that all binders be characterized by the temperature at which the binder has a definite viscosity, and the temperature susceptibility by the temperature interval necessary to increase the viscosity from 80 centistokes to 200,000 centistokes. Cohesion measurements were made on binder films and binder-aggregate mixtures by determining the load required to pull apart the films or mixtures compressed between metal plates; the apparatus is described. It is concluded that the fracture of binder films is generally due to other more complicated phenomena than the overcoming of cohesion. A cohesion fracture is obtained only with binders of high viscosity. A. O.

187. Crystals Obtained from Asphalts. R. Ariano. *Strade*, 1938, **16**, 556–561.—The presence of crystals has been observed on the surface of asphalts obtained from Abruzzi asphalt, and it was suggested that this asphalt contains saturated solution

of a substance which, with increase of temperature, distils off and collects on the surface of the asphalt, thus giving rise to formation of the so-called "efflorescence." A method has been devised for collecting sufficient of the substance for analysis; this consists in extraction of thin films of asphalt under vacuum. The substance proved to consist of very small sulphur crystals. Research work carried out also on asphaltic dusts of different origin showed that the formation of crystals took place only when the extracted asphalt contained over 20% of sulphur, which is about the concentration of saturation. The phenomenon does not occur in petroleum bitumens, owing to their lower sulphur content. It has been observed, however, that petroleum asphalts also form crystals when the sulphur content is increased to 20%. The presence of the crystals does not cause inconvenience in actual use. P. G.

188. Affinity of Hydrophilic Aggregate for Asphaltic Bitumen. H. F. Winterkorn. *Industr. Engng Chem.*, 1938, **30**, 1362.—An attempt is made to determine the various factors which are of greatest importance in the adhesion problem as applied to bituminous road construction. The influence of different pretreatments on the resistance to stripping of bitumen-coated aggregate was determined by means of a wash test. The various pretreatments included washing of the aggregate (before coating with bitumen) with distilled water, aqueous hydrochloric acid, and aqua regia, respectively, and then priming with aniline, phenol, furfural, aniline–furfural, phenol–furfural and lead acetate, respectively. In some cases the wash test was preceded by curing periods in air or in water. The data obtained indicated that :—

1. The stripping-resistance of bitumen-coated aggregate depends on the properties of the bitumen, the surface properties of the aggregate, and the time and condition of contact between mineral surface and bitumen.
2. The effect of acid washing before coating depends on the character of the mineral surface and on the bitumen, but aqua regia is superior to hydrochloric acid as regards improving the adhesion.
3. Priming with furfural and its derivatives is beneficial in improving resistance to stripping.

The evidence accumulated tends to show that furfural and its resinous derivatives might be destined to fill an important place in bituminous road construction.
H. E. T.

189. Asphalt and Bitumen Paints. F. Ohl. *Asph. u. Teer*, 1938, **38** (45), 761–765.—Natural asphalts, such as Gilsonite, are preferred for manufacture of high-quality paints and enamels, but other materials employed, either alone or blended, include coal-tar pitch, oxidized coal-tar pitch, petroleum bitumens, blown and high-vacuum bitumens, stearine and wool pitches and mixtures of bitumen and chlorinated rubber. High-vacuum bitumens are said to be more stable to light than other so-called artificial bitumens, whilst blown bitumens become brown and chalky in direct sunlight, but are superior to the former where the film is subject to bending or shocks. Owing to the large amounts of mineral colour which are necessary in coloured paints, they lack stability; aluminium powder is the most satisfactory and has good protective properties. Bitumen paints should not be used on zinc, owing to the formation of acidic weathering compounds. Bitumen enamels may contain only bitumen and a volatile solvent, or may contain bitumen, resins, softeners, etc., with or without a volatile solvent. Turpentine is not used in linseed oil–bitumen enamels. Essential properties of bitumens for use in paints and enamels are hardness, black gloss, resistance to chemical action, easily and completely soluble, ash content less than 0·2% and wax content less than 2%. Larger amounts of wax cause the surface to become dull and wrinkle. In suitable bitumens the difference between softening point and drop point is about 20° C., and the length of the drop-point thread about 18 mm. Typical formulæ for paints and enamels are given. A. O.

190. Patent on Asphalt. H. E. Potts. E.P. 495,229, 9.11.38. Production of bituminous emulsions free from fillers or solid dispersing agents, having a high stability towards lime and containing 0·6–1% of alkaline metal salts of oxalic acid.
W. S. E. C.

Special Products.

191. Ichthyol—Its Source and Properties. O. C. Blade. U.S. Bur. Mines. Inf. Circ. 7042.—The term Ichthyol is a name applied loosely to certain pharmaceutical preparations manufactured by various chemical processes. The correctly applied word refers to the product obtained by sulphonating and then neutralizing with ammonia a distillate from the oil retorted from a certain high-sulphur bituminous shale found near Seefeld in the Austrian Tyrol. An account is given of the physical and chemical properties of bituminous shales in the Tyrol and of the oils obtained from them. The deposits are exploited by modern mining methods, but little actual data are known concerning the processes of retorting the shale. Ichthyol is a soft, semi-solid, dark-brown material with a characteristic bituminous odour and a burning taste. It has a specific gravity of approximately 1, is soluble in water and partly so in alcohol or ether alone and completely in a mixture of equal volumes of ether and alcohol. It is largely used as an external application for skin diseases and inflammations. Numerous modifications of Ichthyol have been developed for specific purposes—*e.g.*, Ichthargan—obtained by treating the sulphonated product with silver oxide; Ichthalbin, the product of the sulphonated material and albumen, and Ichthoform, the formaldehyde reaction product of the acidified oil. B. M. H. T.

192. Di*iso*butylphenol. J. B. Niederl. *Industr. Engng Chem.*, 1938, **30** (11), 1269.—The physical, chemical and physiological properties of di*iso*butylphenol (p-*tert.*-octylphenol) are described, and conclusive proof of its structure is given. Di*iso*-butylphenol is now manufactured in America on the industrial scale. Many new derivatives have been prepared, including new dyestuffs, a new salicylic and aspirin analogue, new long-chain substituted alicylic compounds, as well as a similarly substituted aliphatic dibasic acid, and also numerous aromatic compounds, all possessing the di*iso*butyl radicle in the side-chain. The di*iso*butylphenol and consequently all its derivatives are prepared from phenol and di*iso*butylene. H. E. T.

193. Patents on Special Products. Chemische Werke vorm H. & E. Albert. E.P. 495,192, 8.11.38. Manufacture of alkaline polyphosphates for use as detergents, washing and softening agents.

Société Carbochimique, P. Ferrero, C. Vaneridries and F. Berbe. E.P. 495,676, 17.11.38. Preparation of ethylene oxide and its homologues from aqueous solutions of the corresponding chlorohydrins by hydrolysis with an alkaline or alkaline earth base.

F. W. Corkery. U.S.P. 2,135,423, 1.11.38 and U.S.P. 2,135,430, 1.11.38. Production of residual elastic gums from liquid still residue from coke-oven light oils by oxidation, without substantial polymerization.

F. W. Corkery. U.S.P. 2,135,427, 1.11.38. Purifying raw aromatic still residue from the treatment of coke-oven light oils by solvent separation and sulphonate precipitation.

F. W. Corkery. U.S.P. 2,135,429, 1.11.38. Purification of still residue for use in resin production. W. S. E. C.

Detonation and Engines.

194. Use of 59 O.N. Motor Spirit in High Compression Engine Developed for Use with Wood Producer. M. Puisais. *Ann. Off. Combust. liq.*, 1938, **13**, 299–312.—The author calculates that the use of producer gas derived from charcoal, in an engine of 8 to 1 compression, will give 34% less power than the same engine when operated on motor spirit, the compression ratio in the latter case being 6 to 1.

Actual experiments indicated that a loss of 42% was obtained, which is ascribed to the differences in the combustion speeds in the two cases, the combustion with motor spirit being the faster. In order to obtain the same power using the charcoal producer, it is necessary to increase the capacity of the engine 1·6 times.

The problem of running such an engine of 8 to 1 compression with 59 O.N. gasoline can be solved by fitting the engine with a regulator which limits the pressure of the

air–fuel mixture before compression to about 44 cm. Hg. If it is desired to use present engines to run on producer gas, supercharging will be necessary in order to obtain the same power output as that available with motor spirit. W. E. J. B.

195. The Maintenance of Diesel Plant at the Stations of the British Broadcasting Corporation. L. Hotine and P. H. Smith. *Diesel Eng. Us. Ass.*, Report No. S. 146.—A description is given of the running and maintenance of twenty-five diesel engines installed at the various stations of the B.B.C.

Some special methods adopted to reduce cylinder wear and piston-ring sticking and to control oil consumption are discussed, and information is given regarding the effectiveness of these measures.

A theory to account for cylinder wear is developed in which the cylinder liner surface is assumed to form itself into "striations" on account of temperature stresses. Photographic evidence in support of this theory is given. The design of the upper extremity of the liner is stated to determine whether or not "striations" will be serious, and some successful modifications are described, based on the principles of the authors' theory, which have, in practice, reduced "striations" to harmless proportions. J. G. W.

196. Diesel Engines and the World's Fuel Supply. J. J. Broeze and J. O. Hinze. *Diesel Eng. Us. Ass.*, Report No. S. 147.—The relation between the diesel engine and its fuel is examined, and it is shown that much would be gained if a more universal attitude were adopted towards designing engines to consume existing cheap fuels, rather than to adapt the fuel to suit individual engines.

Fuel qualities which control the digestibility in an engine are discussed, together with the reliability of certain laboratory tests in assessing the performance in the engine. Engine characteristics, such as the degree of cooling given to the spray nozzle, are shown to affect the combustion of the fuel to a marked degree, bad combustion also leading to other indirect complications. The advantages to be gained by cooling the spray nozzle in order to avoid carbonization are stated to be very great, and a design in which the nozzle is cooled by the fuel is illustrated.

Some general details of a design of engine are put forward by the authors, which, in their opinion, would be practically omnivorous in regard to its fuel. J. G. W.

197. Penetration of Oil Sprays. P. H. Schweitzer. *J. Appl. Phys.*, 1938, **9** (12), 735.—A method of measuring the penetration of a fuel spray tip is described in which the spray tip is made to impinge on a sensitive electric contact. By this means the effect of injection pressure and orifice diameter on spray tip penetration were measured and the results obtained used to check the theoretical dimensional relationships.

Investigations on spray velocity were conducted using a ballistic pendulum, with a specially developed shield to avoid the impact effect of the air carried along with the spray.

Conclusions are reached from the data obtained which lead to certain general relationships between the issue velocity, injection pressure, hole size, oil viscosity, chamber air density, air resistance, and spray penetration. J. G. W.

198. Automotive Two-Cycle Diesel Engines. F. G. Shoemaker. *J. Soc. aut. Engrs*, 1938, **43**, 485–495.—The problems involved in designing an automotive diesel engine that compares favourably with conventional gasoline engines as to size, weight and power lead the author to the belief that the two-cycle engine is the solution, and the paper deals with the design of such a type of engine using similar materials, manufacturing methods and parts as are common practice in gasoline engines.

The engines described are those of the General Motors, Series 71, uniflow two-stroke range, which are built in three sizes—viz., 3-, 4- and 6-cylinder models of 82·5, 110 and 165 maximum B.H.P., at 2000 r.p.m., respectively. A three-lobe helical blower is used for pressure scavenging through piston-controlled intake ports and overhead poppet exhaust valves.

Piston cooling is obtained by an oil spray, and by this means and by coring out the rim of the piston between the piston crown and the ring belt it is claimed that ring-belt temperatures are obtained well below the coking or gumming point of ordinary oils. The injectors are of the unit type operated by rocker arm and push rod from the cam

shaft, and injection pressures vary from 10,000 to 25,000 lb. per sq. in., the plunger being $\frac{3}{8}$ in. in diameter with a displacement of 501 mm.³. The symmetry of design of these engines allows the cylinder block and/or cylinder head to be turned end for end, thus permitting the accessories and exhaust manifold to be fitted on either side, regardless of the direction of engine rotation, which can be reversed by fitting the idler gear on the other side of the balanced shaft and cam shaft which are interchangeable to permit reversing the cylinder head.

A comparison between gasoline, four-cycle diesel and two-cycle diesel engines shows that in the case of the six-cylinder engine the two-cycle design is equal in weight per B.H.P. to the gasoline, and lighter and smaller than the four-cycle diesel engine.

C. H. S.

199. Some Factors Controlling Part-Load Economy. H. Rabezzana. *J. Soc. aut. Engrs*, 1938, **43**, 511–514 and 528.—The author contends that any further worth-while improvement in economy of modern automobile engines is likely to be realized only if improvement in relatively small details can be effected.

The main disturbing factors inherent in the majority of modern engines are :—

(1) Non-uniform mixture distribution.
(2) Low mixture speed in manifold on light loads.
(3) Poor turbulence in cylinder head.
(4) Stratification of the mixture.
(5) Dilution of mixture due to valve overlap and exhaust back pressure.
(6) Poor scavenging around spark plug.
(7) Improper mixture at the spark-plug gaps.

Each of these points is dealt with, details of tests illustrating them being given, and methods of improving the shortcomings suggested. C. H. S.

200. Spark Advance and Octane Number—A Road Test Technique. W. E. Drinkard and J. B. Macauley, Jr. *J. Soc. aut. Engrs*, 1938, **43**, 436–440.—This article describes a method of investigating fuel–car relationship by an improved knock die-out determination technique.

By using a spark advance mechanism operated from the driver's seat and a suitable spark advance indicator, it is possible to obtain curves showing the speed at which knock disappears at any spark setting. Such data are presented in respect to blends of reference fuels and several commercial gasolines.

Knowing the spark advance characteristics of the distributor when operating automatically, and the tolerances allowed by the makers, it is possible from such data to predict the performance of a car as regards knock with its normal ignition equipment.

The data include the effects produced by operating on various fuels with the distributors working automatically but with different basic settings.

It is claimed that by the methods described variations between cars of the same model caused by different distributor characteristics, varying carbon deposit and scale, etc., can be fully investigated. C. H. S.

201. Correlation of Road and Laboratory Octane Numbers. J. R. Sabina. *J. Soc. aut. Engrs*, 1938, **43**, 416–420.—This report submits the findings of the Correlation Group of the Co-operative Fuel Research Committee, which, at the November 1936 meeting, was authorized to make a study of the correlation between laboratory and road knock-ratings in the then current automobiles. A preliminary study based on information submitted by individual Companies in 1934, 1935 and 1936 cars indicated the desirability of collecting further data under controlled conditions. The results of that work have already been presented in September and October 1937. The Correlation Group have also analysed the report of the Institute of Petroleum Knock-Rating Panel based on British cars and fuels, and have concluded that the same factors influence both the British and American data in about the same degree, and assume, therefore, that any laboratory method of test which is shown to improve the correlation between road and laboratory ratings regarding American cars will apply in like degree to the British cars.

The best correlation appears to be obtained by taking a mean of the research and motor method ratings as the laboratory rating, but in view of the complication of using

two methods, the question of relative reproducibility and the extent to which the fuels tested are representative of commercial gasolines, the Group recommend that no change from the motor method be made at present. C. H. S.

202. Application of Statistical Concepts to the Knock-Rating Problem. J. M. Campbell and W. G. Lovell. *J. Soc. aut. Engrs*, 1938, **43**, 421–426.—From the available data on road and laboratory knock-ratings, the authors have begun a statistical analysis to determine the probabilities of occurrence of errors of various magnitudes. They find the random error among successive measurements in road tests to be from three to six times that between laboratory ratings in the C.F.R. engine, and the variability among ratings made in different makes of car only slightly greater than that among repeated tests in a single car of one make.

This high random error in car ratings makes it necessary to obtain a large number of road ratings on any particular gasoline before a reliable comparison can be made between it and another fuel with the same precision that is obtained in the mean of three or four laboratory ratings on each fuel. C. H. S.

203. Practical Approach to the Road Detonation Problem. A. J. Blackwood, C. B. Kass and G. H. B. Davis. *J. Soc. aut. Engrs*, 1938, **43**, 427–433.—The authors contend that the average fuel octane-number requirement of existing cars and the octane requirement of the average car are values of little practical significance. They show how the road octane number of a fuel varies in some cases when tested at varying knock intensity, and how the spread of ratings of a fuel in a series of cars gives no indication of comparative behaviour, as a value of, say, 70 octane number may have been accompanied by objectionable knock, whereas a rating of 65 octane number in another car may have represented only a trace knock.

For these and other reasons described it appeared desirable to tackle the problem of evaluating fuels from another angle. The procedure adopted was to select a large number of privately owned cars, and tests were made on reference fuel blends and branded products, with the idea that if the cars selected constituted a representative cross-section of the total cars on the road, then the results obtained should be representative of actual service conditions.

Two such practical surveys were made, and a statistical analysis of the results is given. The data were considered on the basis of their representing 100% of the cars on the road, each of the 265 cars tested being given a value (calculated from the number produced, mortality rate, etc.) representing its proportion of all cars on the road. Cumulative curves are given showing the percentage of cars which will give varying intensities of knock on a reference fuel blend of a given octane number, and the knocking tendencies of six non-premium fuels are shown in a similar way. These six fuels differ markedly in the percentage of cars in which they develop a given knock intensity. These differences constitute a basis for the development of a practical method of relating laboratory and road ratings, since the best laboratory method should be one which shows a corresponding linear increase in the percentage of cars satisfied as the numerical value of the laboratory rating increases. The results on these six fuels are shown when the laboratory ratings by three different methods are used. It is concluded that laboratory ratings are useless unless they predict relative performance of fuels in the cars actually being operated by the public. As a result of these two surveys it is felt that this method of test yields data of practical value. C. H. S.

204. Rating Aviation Fuels in Full-Scale Aircraft Engines. H. K. Cummings. *J. Soc. aut. Engrs*, 1938, **43**, 497–503.—The first report of the Co-operative Fuel Research Committee dealt with the results obtained on three series of base fuels in four representative full-scale aircraft engines and assignments were made for further work as follows :—

(1) Establish the validity of the C.F.R. Recommended Procedure for rating fuels above 87 octane number in full-scale engines.

(2) Conduct full-scale engine tests in the range from 87 octane number to the highest octane number available.

(3) Concurrently with Item 1, develop or revise knock test methods leading to correlation with full-scale engine data.

The present report covers work under Items 1 and 2 and presents partial data required under Item 3.

Since presentation of the first report the National Research Council of Canada have become a co-operating member of the group, and have carried out tests which are described, using a 14-cylinder Armstrong-Siddeley " Jaguar " engine. The results of these tests are in substantial agreement with the work in the first report. The Wright supplementary tests of olefinic fuels show that the A.S.T.M. method satisfactorily predicts the full-scale value of very highly unsaturated fuels of both leaded and unleaded type up to 84 A.S.T.M. octane number.

The tests of commercial 87 A.S.T.M. and 100 Army octane-number fuels containing 2½–3 c.c. of $PbEt_4$ show that the A.S.T.M. method underrates 87 octane leaded fuels by 6 to 8 octane numbers, and 100 octane leaded fuels by 2–4 numbers. From the work of both reports the following tentative conclusions are arrived at.

Unleaded *iso*-octane blends of 84 A.S.T.M. octane number or more will be lower in full-scale rating than leaded blends of equal A.S.T.M. rating containing over 2 c.c. of lead per gallon.

Benzol blends generally will not be equal in full-scale rating to leaded blends of equal A.S.T.M. rating if the A.S.T.M. rating is over 84. When benzol blends of 84 or more octane number are compared with *iso*-octane blends of equal A.S.T.M. rating, they will on the average be higher, and rarely lower, in full-scale rating. The behaviour of high-octane-number benzol blends in full-scale engines is widely variable as a result of engine type and operating conditions. It is apparent, however, that any revised knock-test method should not be more severe on aromatic blends than the A.S.T.M. method.

Regarding assignments 1, 2 and 3, it is found that :—

(1) The recommended procedure of bracketing the test fuel between blends of special reference fuels M.1 and S.1 is satisfactory.

(2) Before 100 octane-number fuels employing bases of diverse chemical type can be used in service with reasonable safety extensive full-scale investigations are necessary.

(3) Revision of the A.S.T.M. method is necessary. As a result of extensive studies, a Laboratory Procedure Group is considering immediate modification, which it is believed will give results more in line with full-scale practice than the A.S.T.M. method. C. H. S.

Coal and Shale.

205. Modern By-Product Coking Design. Anon. *Fuel Econ.*, 1938, **156** (14), 327.—The article describes the evolution of the modern coke-oven, laying particular stress on the early work of Koppers.

Advances in oven design in practice have been chiefly in the direction of a reduction of operating costs and an improved thermal efficiency. These points are shown in the design of a modern combination circulation oven, which is described and illustrated in the article. W. E. J. B.

Economics.

206. World's Petroleum Industry in 1938. Anon. *Przem. Naft.*, 10.1.38, (1), 13–15.—The paper gives a review of political happenings in the past year and discusses their influence on the oil industry and trade. It is stated that the general lowering of the production in 1938 is by no means an indication of an exhaustion of the existing oil resources.

Tables are given showing the prices of petroleum products (in U.S.A. only) and the approximate production in 1938 of most of the oil-producing countries. E. J. W.

207. Diesel Propulsion in the Development of Communications. Anon. *Przem. Naft.*, 10.12.38 (**23**), 635.—The increase in importance of the diesel engine over the spark-ignition engine is mainly due to three factors : (*a*) the high thermal yield of the diesel engine ; (*b*) the low cost of the fuel ; (*c*) the very large range of mechanical power for which diesel engines can be used. The maximum power developed by spark-ignition engines is 3000 Mech. H.P., as compared with 25,000 Mech. H.P. developed by diesel engines used in the shipping and rail industry.

Shipping. In the last twenty-five years the ratio of the tonnage of diesel-propelled ships to the total tonnage of the world's mercantile fleet rose from 0·45 to 22·5% and a further increasing tendency is observable.

By the end of September 1938 out of 685 ships being built all over the world 433—*i.e.*, 65%—were equipped with diesel propulsion.

Of the shipbuilding countries, Denmark heads the list with 100%, which means that all the ships built there are motor propelled. Italy, Sweden and Holland follow next. Great Britain is in the sixth place with 57·2%.

Rail Traffic.—Rail cars and diesel-propelled locomotives are gaining in popularity, particularly for local traffic. In a given table Germany heads the list with 671 rail cars and 1171 diesel locomotives, followed by France, Argentine and Italy.

Road Traffic.—Here the competition between the railways and mechanized road transport has an inhibiting effect. The price ratio of gas oil to petrol seems to have a determining effect on the development of diesel lorry transport.

Air Traffic.—Here also the above ratio plays an important rôle. The considerable weight of the diesel engine is a disadvantage. Since 1929 experiments were being carried out in Germany with diesel aero-engines, and in 1932 the first passenger plane with diesel propulsion was put into regular service. Satisfactory results in this sphere were also obtained in the U.S.A. in 1931.

In the course of the last five years it was possible to raise the efficiency of diesel aero-engines from 25 to 40 Mech. H.P. per litre, lowering at the same time their weight from 1·1 to 0·6 kg. per Mech. H.P. E. J. W.

208. Estimated Cost of a Five-Year Drilling and Prospecting Plan in the Carpathian Area. M. Mrazek. *Kop. Naft. Polsce*, November 1938, **11**, 332.—In connection with a five-year plan for drilling and prospecting work in the Polish Carpathian area the author gives an estimate of the costs. Tables are given showing the dimensions, quantities and cost of drilling equipment, casing and tubing as distributed over five years. Other tables give in detail the cost of different factors involved in drilling and prospecting. The total cost as estimated amounts to 75,087,000 zlotys. E. J. W.

209. Five-Year Plan for Prospecting and Drilling Work in the Carpathian Area. K. Tolwinski. *Kop. Naft. Polsce*, November 1938, **11**, 334–336.—Poland's oil production is steadily decreasing, although the number of bore-holes increases. This leads to the conclusion that the resources of the present oil-fields are being exhausted. Therefore the necessity arises to develop intense drilling and prospecting activities in the Carpathian Area, where there is strong evidence that new oil-fields can be found. The author suggests a programme of work extending over five years. The area is divided up into five regions, in which drilling and prospecting equipment is distributed according to the requirements of the geological structure and complications that are likely to be encountered. E. J. W.

210. Reorganization of Mechanical Transport in Czechoslovakia. Anon. *Przem. Naft.*, 25.12.38 (**24**), 660.—The far-reaching changes in the geographical and economic structure of Czechoslovakia have brought about the necessity of a reform of the mechanical transport of the country.

The main decisions that have been taken by the government in this connection are these :

(1) Abolition of all taxes on motor-cars of any type from January 1st, 1939.

(2) Abolition of all restrictions in the sphere of so-called Industrial Road Transport (car park taxes, etc.).

(3) Abolition of a number of limitations of the commercial goods transport. No restrictions are made for the freight charges of lorries below 3 tons capacity. Lorries of over 3 tons capacity, however, are brought under the direct or indirect control of the railways. As a result of this restriction the industrial goods transport of individual companies is almost entirely limited to rail transport.

(4) In bus passenger transport the tax on each ticket is reduced from 20 to 10%.

Parallel with these reforms, the existing road system is to be enlarged. E. J. W.

History of Petroleum.

211. History of Petroleum in Persia to the Beginning of the Twentieth Century. L. Lockhart. *Rev. Pétrolif.*, 4.11.38 (810), 1421–1425; 11.11.38 (811), 1455–1459.—Archæological research shows that bitumen was used in the Sumerian epoch (5000–6000 years ago). It was used as a binder, in making ornaments, for waterproofing pottery and for caulking. The investigation of the use of liquid petroleum is more difficult, and depends on documental and philological evidence. The word naphtha is of oriental origin, but whether Persian or Semitic is debatable. It certainly meant petroleum in ancient Persia. Gas issues were important, being employed in religious rites. However, geological evidence is against the existence of a seep on the site of a temple at Masdjid-i-Sulaiman (596 B.C.). Crude oil is unlikely to have been burned in the temples because of the fumes.

Firdousi describes how Alexander, when governor of Persia, used oil fires for fusing building materials, and there are repeated references to flaming arrows which undoubtedly imply the use of oil.

The oil at Bakou is frequently mentioned from A.D. 272 onwards, and in 1574 it was noted that the oil from this place was transported widely. Apparently it was during the early part of the eighteenth century that the Hindus erected a temple at Sourakhani over a gas seep. After various changes Russia regained Bakou in 1806, but the bulk of the oil was still exported to Persia. In 1819 the output was estimated at 4000 tonnes. Oil was also exploited primitively at Masdjid-i-Sulaiman, Naft-i-Safid, etc.

In 1884 Hotz obtained a concession from the Persian Government and put down some shallow pits. His deeper well was badly placed. The exploration rights changed hands several times without success being achieved, and in 1901 they were acquired by D'Arcy. After costly and fruitless work at Tchiab-Sourkh in 1902–1904, he sought aid which resulted in the formation of the Concessions Syndicate in 1905. When almost at the end of its resources, the latter drilled a well at Maidan-i-Naftun which struck a large oil reservoir at 360 m., and was the first of a series of prolific producers. In 1909 the Anglo-Persian Oil Co., Ltd., was formed.

Bitumen which was used for preserving mummies was undoubtedly the source of the word mummy in Persian. The bitumen was highly esteemed, being collected with great ceremony, and was believed to have great curative properties. G. D. H.

BOOK REVIEW.

Standard Methods for Testing Tar and Its Products. Second Edition. 1938. Pp. 434. Standardization of Tar Products Tests Committee. 166, Piccadilly, London, W.1. Price 21*s*. net.

The first issue of these methods was in 1929, following a decision reached at a Tar Conference held in Manchester some two years after the first issue of the Institute of Petroleum Technologists' "Standard Methods for Petroleum Products" (1924). There can be little doubt but that the example of the petroleum industry brought home to the tar industry the real necessity for a similar effort. The tar distillation industry had been in existence many years prior to the petroleum industry, and in different laboratories, some small, some large, quite crude experimental methods, incapable of giving anything but approximate results, had been practised. The old retort distillation test for crude benzole, with the bulb of the thermometer in the liquid, and an arbitrary "stop point" at 120° C. is a good example.

Within the last twenty years there has also been a change in the requirements of many of the products; for all practical purposes road tar was a new material, and motor benzole was soon found to require methods of test which had no significance in the old days of benzene as a raw material for the dyestuff and other "chemical" industries—the "gum" tests, for example.

Methods of test obviously do not call for critical comments or any discussion of detail, seeing that they are all sponsored by Committees and Panels composed of those in daily touch with the methods. As with the I.P. standardization work (with which there has been a happy working contact), revision of the First Edition (1929) has been carried out through a very similar organization, certain tests omitted, others added, with considerable increase in size, the Second Edition running to over 400 pages.

Almost from the commencement the main Committee and the Revisionary Panel have been fortunate in having as Chairman Mr. H. W. James, and as Hon. Sec. Mr. R. M. Drake. Whilst the many members of the various Committees and Panels have done yeoman service, the writer feels confident all will agree that the energy, experience and tact of the Chairman and Hon. Secretary have been of the utmost value in ensuring the production of a Second Edition which is a fine example of team work in this important industry.

J. S. S. BRAME.

BOOKS AND PUBLICATIONS RECEIVED.

Report of the Fuel Research Board for the Year Ended 31st March, 1938. Pp. x + 255. H.M. Stationery Office, London. Price 4*s*.

Further work is reported on the synthesis of lubricating oils from the gases produced in the total gasification of coal. The spirits produced by the process have been found after secondary treatment to possess good characteristics in regard to coke numbers, both before and after oxidation, setting point and flash point, whilst the other properties are up to the average values for mineral oils. The absolute viscosity range does not quite lie within that suitable for a winter grade oil, but it is thought that this could be remedied in future preparations by distilling off a smaller fraction of the less viscous constituents.

Experimental work has been put in hand to determine whether the high rates of wear encountered in coal-dust diesel engines can be reduced to practicable proportions by suitable choice of material for the liner, piston and rings. The results so far obtained are promising.

British Standard Specification No. 143, December, 1938, for Malleable Cast Iron and Cast Copper Alloy Pipe Fittings for Steam, Water, Gas and Oil. Pp. 58. British Standards Institution, 28, Victoria Street, London, S.W.1. Price 3*s*. 6*d*.

This specification deals with the dimensions of malleable cast iron and cast copper alloy pipe fittings, but is not concerned with the composition of the material. The fittings are, in general, suitable for working pressures up to 200 lb. per sq. in. in the case of water and up to 150 lb. per sq. in. in the case of steam, gas or oil.

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Geology.

212. Carterville-Sarepta and Shongaloo Fields, Bossier and Webster Parishes, Louisiana. G. D. Thomas. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1473–1503.—The sub-surface rocks of these fields consist of Tertiary sediments (Claiborne & Wilcox, 1150 ft., and Midway 500 ft.), and the Cretaceous and Comanche formations.

The Annona chalk is the most easily recognized chalk member of the Cretaceous, having a thickness of 120 ft.; its base has been used as a datum plane on the structure maps included in this paper. In the Comanche, no well at Shongaloo or Carterville has yet penetrated below the Glen Rose anhydrite, which is approximately 500 ft. thick at Shongaloo.

The Shongaloo field, discovered in March 1921, is an east-west elongate dome, separated from the Carterville-Sarepta field on the west by a saddle and from the Cotton Valley structure on the south also by a saddle. The only producing sand at Shongaloo is the Buckrange of basal Ozan age. It is found at an average depth of 2600–2650 ft. and is very variable in character and thickness. It is thought that the amount and extent of production is governed as much by the variable sand conditions (porosity and thickness) as by structure.

The Carterville-Sarepta field appears to be a north-west to south-east extending anticline on which six small local closures exist. The dip on the south side of the anticline is apparently steeper than that on the north. A description of the six local closures is given. Three producing sands occur, the Buckrange (oil), the topmost sand member of the Tokio (gas) and the second sand member of the Tokio—60 ft. below the gas sand—produces oil in the Carterville area.

The origin of the structures in both fields is uncertain, although it is generally agreed that they are the result of a small amount of flowage of salt beds of Comanche or pre-Comanche age which are thought to underlie most of North Louisiana and part of Arkansas. G. S. S.

213. Sugar Creek Field, Claiborne Parish, Louisiana. C. C. Clark. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1504–1518.—This field was discovered in March 1930 and has a producing area of about 4000 acres. A generalized section is given of the formations occurring in the field; these are: the Eocene (Claiborne), Upper Cretaceous (Gulf Series) and the Lower Cretaceous (Trinity).

Structurally, the field is an anticline about five miles long by three miles wide. At the surface it occurs as an imperfect inlier of the Cook Mountain formation surrounded by the overlying Cockfield. Two structure contour maps are furnished.

Gas is obtained from two reservoirs in the Trinity series—the Kilpatrick and Darrett zones. Oil is found only in economic quantities in the Darrett, where both gas and oil occur in porous beds distributed throughout a thickness of 175–275 ft. The total accumulated oil production on 1st January, 1938, was 86,000 brls., all from the Darrett zone. G. S. S.

214. Stratigraphy and Structural History of East-Central United States. N. Ballard. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1519–1559.—This paper summarizes some facts concerning the stratigraphy of Michigan, Ohio, Indiana, Illinois, Kentucky and Tennessee.

A series of cross-sections are given in order to show as many stratigraphical details as possible, and samples from approximately 525 wells have been examined to assist in this work. A tentative correlation table and seven logs are also included in the paper.

Two major periods of folding occurred in the area, the first at the beginning of Onondago time. This folding probably reached its maximum towards the end of Hamilton deposition, for on the flanks of the Ozarks there was much post-Hamilton faulting.

The second period of major faulting occurred at the end of Mississippian time. When the Pennsylvanian sea encroached over the old land surface, hundreds of feet of beds had been removed as the Pennsylvanian overlaps St. Peter sand in northern Illinois.

The last uplift to affect the area arose after the deposition of the Pennsylvanian and before the Cretaceous was laid down, as faults in Kentucky displace the Pennsylvanian but do not cut the Cretaceous. G. S. S.

215. Jesse Pool, Pontotoc and Coal Counties, Oklahoma. W. B. Boyd. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1560–1578.—The Jesse Pool and the Fitts Pool (one mile distant) are closely related both stratigraphically and structurally. The Jesse Pool itself is about four miles long and one mile wide.

The oldest formation drilled in the Jesse is the Arbuckle limestone, penetrating it 87 ft. This is followed by rocks of the Simpson Group, Siluro-Devonian (Hunton Limestone), Mississippian and Pennsylvanian (Morrow Group and Des Moines Group).

The Jesse Pool lies on a large anticline which is faulted on the south side. The faulting has a maximum throw of 1300 ft. and occurs in a series of step faults, all of which are normal.

Production may be generally divided into four zones and areas: "Wilcox," Bromide, Hunton and Pennsylvanian. The best production is found in the "Wilcox," which is confined to a small area on the crest of the anticline. The average initial potential gauge was approximately 4000 brls. a day, the estimated ultimate production being 6,650,000 brls.

From the Bromide sand, the average initial production was 1800 brls.; the estimated ultimate yield is 1,680,000 brls. Production from the Hunton is erratic, the initial yield ranging from 63 to 3480 brls., and an estimated ultimate production of 4,000,000 brls. from the present developed area.

From the Pennsylvanian, production is confined to the Wapanucka and Atoka formations. Three gas wells have been completed in the Wapanucka sand, but no showings of oil have been observed, and five wells have been completed in the "Gilcrease" sand (Atoka) with an average production of 72 brls. a day.

On 1st January, 1938, the Jesse Pool had produced 1,704,164 brls. G. S. S.

216. Geology of Bellevue Oilfield, Bossier Parish, Louisiana. A. F. Crider. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1658–1681.—The Bellevue Oilfield is located in T.19 N., R.11 W., Bossier Parish, and is surrounded by the producing oilfields of north-western Louisiana.

The formations occurring in the area are of Upper Cretaceous and Tertiary age. The oldest sediments reached to date are black marine shales and limestones of the Cotton Valley formation which have been penetrated at 1429 ft. The remaining formations of the Upper Cretaceous follow, the close of the System being marked by a chalky shale of Arkadelphia age, which on the crest of the structure is about 40 ft. thick. Overlying this bed is the Midway clay (Tertiary). This consists of shale which immediately underlies Pleistocene and Recent deposits. Its uniform thickness is about 400–600 ft., though on the crest of the dome the thickness has been partly reduced by truncation, leaving only 100 ft.

Structurally, Bellevue is a deep-seated dome, probably of salt origin, with overlying sands across the crest in which oil has accumulated. From the top of the dome to the base of the syncline separating Bellevue and Cotton Valley, the amount of uplift,

as shown on Upper Cretaceous data, is about 1800 ft. and 2500 ft. on Lower Cretaceous data.

Oil is obtained from the Nacatoch sand at a depth of 300–400 ft., and gas and oil from the junction of the Upper and Lower Cretaceous at 1800 ft.

Since its discovery in 1921 to 1st January, 1938, the field has yielded 9,860,430 brls., the peak production being reached in 1923 (2,250,057 brls.). The field was closed during 1932–1933 owing to depression conditions. The producing area of the field is 900 acres and the yield per acre to 1st January, 1938, is 10,996 brls.

G. S. S.

217. Comparison of Upper Cretaceous Deposits of Gulf Region and Western Interior Region. L. W. Stephenson and J. B. Reeside, Jr. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1629–1638.—In the Gulf region the Upper Cretaceous sediments are chiefly of marine origin. The most complete section is the classic example in east central Texas, and this may be taken as a standard. The series includes the Woodbine Sand, Eagle Ford shale, Austin Chalk, Taylor marl and the Navarro group, having an aggregate thickness of about 3000 ft. Traced both south-west and north-east from east central Texas, however, the sequence changes markedly.

In the Western Interior region the Upper Cretaceous deposits may be classified into three types : (i) an eastern belt of marine fine sediments (Great Plains sequence); (ii) a middle belt of mixed continental and marine sediments (Rocky Mountain sequence); (iii) a western belt of sandstones and conglomerates mainly non-marine, an incomplete sequence.

In both regions fossils are abundant. Although numerous species are restricted to either one region or the other, many of them are indentical or analogous to allow of correlation. The ranges of some of these fossils are shown in a table.

G. S. S.

218. Olympic Pool, Hughes and Okfuskee Counties, Oklahoma. A. W. Tillotson. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1579–1587.—The Olympic pool is in the east central part of Oklahoma, just off the north-east edge of the Seminole uplift.

The main producing horizon is from the Senora formation, a lenticular sand member—"Olympic Sand." Minor production is also obtained from the Pennsylvanian formation (Calvin Sand and Cromwell Sand) and the Hunton limestone of Siluro–Devonian age.

To date 326 oil wells have been completed and all but four of these derive their oil from the Olympic Sand. It is estimated that the pool will eventually recover 16–24 million barrels from this horizon.

G. S. S.

219. Studies of Insoluble Residues from "Mississippi Lime" of Central Kansas. T. C. Hiestand. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1588–1599.—From a study of the stratigraphy aided by the use of insoluble residues, it is shown that the Mississippi lime in Central Kansas can be subdivided into zones or formations. These zones are proved to be very similar to the members of the Boone limestone of Missouri.

Oil is obtained from one or both of two of the zones in certain pools. Accumulation in many places is apparently due to stratigraphic traps rather than to merely structural closures. Accompanying the paper are two cross-sections arranged with the top of the Missouri series as the datum plane to show the subdivisions of the Mississippi lime.

The author concludes that the subdivision of this formation in all parts of Kansas and adjacent areas should furnish data to make more complete interpretations of the history of the Central Kansas buried uplift and other important structural features.

G. S. S.

220. Stratigraphy of Upper Cretaceous Series in Mississippi and Alabama. L. W. Stephenson and W. H. Monroe. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1639–1657.—The Upper Cretaceous sediments of the Eastern Gulf region outcrop in a great crescentic band which wraps around the south-west end of the plunging Appalachian Highlands. This band is 500 miles long and centrally is 75 miles wide, the sediments having a maximum thickness of about 2300 ft.

The Upper Cretaceous in west central Alabama and in east central Mississippi is

readily divisible from below upward into four formational units; the Tuscaloosa, Eutaw, Selma chalk and Prairie Bluff chalk.

Deposition of the Upper Cretaceous was not continuous, sedimentation having been interrupted from time to time. These breaks are recorded in at least four unconformities. The first of these is between the Tuscaloosa and the overlying Eutaw, and has been traced throughout the eastern Gulf region.

The next unconformity is that separating the Tombigbee sand member of the Eutaw from the overlying Selma chalk; the break is believed to be widespread in the area.

The third break is about 300 ft. above the base of the Selma chalk and a few feet above the Arcola limestone. The position of this break is marked by a thin band of phosphatic fossil moulds.

The fourth break, separating the Selma chalk from the overlying Prairie Bluff chalk, is an important one. It has been traced for more than 300 miles in Mississippi, Alabama and Georgia; in places it marks a northern transgression of the Prairie Bluff chalk over a great thickness of older Cretaceous sediments.

The following fossil zones have been recorded through Mississippi and Alabama: the *Exogyra ponderosa* zone which includes the Tombigbee sand and the lower two-thirds of the Selma chalk. A narrow and persistent zone in the Selma chalk about 180 ft. above the Arcola limestone is characterized by *Diploschiza cretacea* and by *Terebratulina filosa*. This zone has been traced from Montgomery County to Tupelo (Mississippi), a distance of 220 miles. Including the upper third of the Selma chalk and the Prairie Bluff chalk, the *Exogyra costata* zone can be traced, and the *E. cancellata* zone can be followed throughout the area in the lower 200 ft. or less of the *E. costata* zone. G. S. S.

221. Relation of Rough Creek Fault of Kentucky to Ouachita Deformation. W. L. Russell. *Bull. Amer. Ass. Petrol. Geol.*, 1938, **22**, 1682–1686.—A belt of thrust faults and folds extends from the Mexican border to Arkansas, forming one of the major structural features of the continent.

The Ouachita structures exhibit no sign of diminishing where they disappear below the Cretaceous and Tertiary sediments of the Mississippi Embayment. The Rough Creek fault system of Kentucky and its associated faults are similar to the Ouachita structures on the west.

The author therefore discusses the evidence as to whether the Rough Creek fault is an eastern extension of the Ouachita deformation. Of various suggestions made, one is quoted from evidence obtained from wells drilled in the Mississippi Embayment in north-west Tennessee between the Ouachita and Rough Creek structures. Here wells have penetrated Palæozoic rocks which are definitely disturbed and altered.

G. S. S.

222. Oil Bringing a New Epoch in Eastern Venezuela. C. O. Willson. *Oil Gas J.*, 3.11.38, **37** (25), 14.—The Eastern Venezuelan oil production constitutes about 16% of the 530,000 brls. daily output of Venezuela. In the Maracaibo region the older fields are now declining in output, but exploratory work is still going on.

The area of search in Eastern Venezuela is about 450 miles long and 350 miles broad. In it Quirequire with a daily production of 70,000 brls., provides most of the oil. This field has 247 wells, of which 209 are flowing. 12,700 acres have been proved, and oil is obtained from Pliocene sand lenses under shore-line conditions at depths of 1800–3250 ft. The very thick oil zone is subdivided by a water sand. The Pedernales field gives oil from the Middle Miocene at depths of 5000–6200 ft. on a north-east to south-west trending anticline. High pressures and steep dips render the work rather difficult.

Production from the 40 wells at Temblador is derived from the Middle Miocene on the up-thrown side of a normal fault at depths of about 3900 ft.

Prolonged seismic work preceded drilling at Oficina, where five producing wells, which have proved an area of 3 sq. ml., are shut in. The average depth of the producing sand is 5700 ft., but deeper and shallower oil-sands have been reported. At Santa Ana there is gas-distillate production from a depth of 7500 ft., and low-gravity oil production has been found at El Tigre.

The geological knowledge of this area is largely the result of geophysical work, for the area is cloaked by a thick cover of Pliocene deposits. G. D. H.

223. Exploratory Work in Venezuela. C. O. Willson. *Oil Gas J.*, 10.11.38, **37** (26), 14–17.—Most of the exploratory work is taking place in eastern and central Venezuela, but some is going on in the west, extending to the Colombian border. At present twelve geological crews, four magnetometer crews, nine gravity crews and fourteen seismic crews are at work. There is also one Eltran party.

A geosyncline appeared in Cretaceous times, and in the Oligocene the well-defined Maracaibo basin was separated off. This covers about 63,000 sq. km., whereas the less well-defined Maturin basin in the east covers 68,000 sq. km. About two-fifths of the total area is under concession.

There are about 2700 producing wells, of which 300 are in eastern Venezuela. About half of them are being pumped. Western Venezuela and the Maracaibo area give about 440,000 brls. of oil per day. The bulk of the production comes from depths of 2000–3750 ft. The deepest well is the El Roble wildcat near Oficina, which is drilling at over 9000 ft.

A geological map shows the positions of the fields and of the wildcats.

G. D. H.

224. Western Venezuela Drilling Operations Show Efficiency Against Hazards. C. O. Willson. *Oil Gas J.*, 1.12.38, **37** (29), 26–28.—Western Venezuela is essentially a supplier of heavy oils. Oilfields now run almost continuously for nearly fifty miles along the northern half of the eastern side of Lake Maracaibo. Many wells have been drilled in the lake. It is possible that the decline in production of the old fields may be offset by newer ones. Bachaquero is the most southerly and Tarra the most westerly field.

The Lake fields have about 2000 producing wells, of which 33% flow, 62% are pumped and the rest are on air or gas lift. Ambrosia, La Rosa and Benitez have about 775 wells, Tia Juana 300, and the rest are at Lagunillas. The Ambrosia-La Rosa wells are about 2300 ft. deep; those of Lagunillas about 5000 ft.

The Maracaibo pools yield oil from Cretaceous–Mid-Miocene beds; (*a*) on anticlines and domes of considerable variety; (*b*) on gentle monoclines with sands or sandstones which lense out up dip; (*c*) on combinations of (*a*) and (*b*). Shore-line conditions are responsible for most of the oil accumulations now exploited in the Maracaibo basin. These are not near the margin of the basin, but close to the central part of the present topographic depression. G. D. H.

225. Colombia to Witness Active Drilling Campaign in 1939. C. O. Willson. *Oil Gas J.*, 22.12.38, **37** (32), 14–16.—Most of the concessions granted lie in the Magdalena valley, in the main east of the river. The area extends along the river for about 200 miles from Bodega Central in the north to Laclorada in the south. A 335-mile pipe-line connects the fields of the De Mares concession (Infantes and La Cira) with Cartegena on the Caribbean. The daily oil output is 60,000 brls.

The wildcat Socony-Narina No. 1 is drilling at 5000 ft. on the Narina uplift. Three wells have been drilled on the Las Monas anticline, one of which is a small producer. A well is being drilled at San Fernando, and drilling is expected to begin shortly on the Cantemplora and Carare concessions. Elsewhere geological surveys are in progress. G. D. H.

226. Remarkable Developments in Barco Concession. C. O. Willson. *Oil Gas J.*, 15.12.38, **37** (31), 18.—When the 260-mile pipe-line from Petrolea to Covenas on the Caribbean is completed, rapid developments are expected to take place in the Barco concession. This concession, near the Colombian–Venezuelan border, is about 75 miles long and 25 miles broad, and is the site of numerous oil and gas seeps. These were exploited primitively, and in 1919 a shallow test in the Rio de Oro district in the north showed heavy oil. In later work in 1933 Petrolea No. 1 blew in at about 500 ft. and caught fire. Thereafter several wells were drilled at Petrolea and a further two at Rio de Oro. Geological work and wildcatting have been going on in other parts of the concession.

At Petrolea, production is from a much-faulted anticline. Most of the oil comes from siltstones and limestones in the Cogollo formation at 450–650 ft. The initial

output per well ranges from a few hundred to 3000 brls. per day of 45° A.P.I. oil, giving 50% gasoline on atmospheric distillation.

The four Rio de Oro wells yield 37–40° A.P.I. oil from a sandstone in the Catatumbo formation at depths of 1200–1500 ft. G. D. H.

227. **Petroliferous Beds of Egypt.** V. Stchepinsky. *Ann. Off. Comb. liq.*, Sept.–Oct., 1938, **13** (5), 823–874 (1 map).—The dj. Zeit seep has long been known, and the search for oil began in 1868. Evidences of oil have been observed in the Gulf of Suez zone, on the Red Sea coast and in north Sinai. The first producing field was opened up at Djemsah in 1909, but from 1914 onwards Hurghada has been the main producer. In late years the production has fallen off. New legislation was recently introduced which has led to the taking up of many permits, in regions from Sinai to Ras Benas on the Red Sea, and west of the Nile between Alexandria and Cairo.

There are two main features in the stratigraphy of the Red Sea basin: (i) A big gap between the Crystalline and the Miocene in the primitive anticlinal zones, pointing to intense erosion in Cretaceous, Eocene and Oligocene times. (ii) Lateral variation of facies. There is also a lack of correlation between some areas, and altogether the establishment of a general stratigraphic column is rather difficult.

The various stratigraphical horizons are briefly described. The term "Nubian sandstones" has only a lithological and not a stratigraphical significance, for it has been used for beds ranging from Carboniferous to Senonian in age. The Oligocene is missing and the Jurassic is best known at dj. Moghara.

The principal earth movements took place at the end of the Eocene, and there were accessory movements in Pliocene times. The oil-bearing beds are grouped as occurring on (*a*) fundamental anticlines and (*b*) on superficial anticlines. The former have crystalline cores and the latter lie in the synclinal areas between the former. In the Cretaceous there was a transgression from north-west to south-east. A new transgression came from the same direction in the Miocene, which period ended in a long lagoonal phase. The fundamental anticlines are suitable for testing Eocene and Cretaceous beds, where present, but not so the superficial anticlines where the Miocene is thick.

The beds and structure of the various areas with evidences of oil are described: North Sinai, Habachi, Bir Abou Kitifa, dj. Kochera, Oued Gharandel, dj. Tanka, Oued Matulla, dj. Mezzazat, Abou Durba, Ras Mohammed, Ras Gharib, Ras Dib, Zeitia, Ranim Island, Ras el Bahar, Ras Djemsah, islands east of Djemsah, Abou-Chaar, Hurghada, Abou-Mingarh, Jiftoun Kebir Island, and Dichet el Daarba. Many beds show traces of oil, but few are important. Many seeps are associated with faults and some with dykes. The Nubian sandstone is generally water-bearing. The productive horizons are: (i) granitic sands of uncertain age between the granite and the Campanian (Hurghada); (ii) Campanian (?) (Hurghada); (iii) base of Miocene (Hurghada) and below the Lagoonal formation (Djemsah); (iv) Lagoonal formation (Hurghada and Djemsah). All the present producing structures have a granite core.

The history of the oil exploitation is summarized. In 1931 a maximum output of 285,000 metric tons per annum was attained.

Several mother rocks may exist, amongst which the Cretaceous is prominent. As yet the exploration has only been shallow. G. D. H.

228. **Recent Exploration in the Carpathian Foreland.** Anon. *Bohrtech. Z.*, 1938, **56** (11), 164–166.—In the last two years some 20,000 sq. km. of the foreland have been mapped and seismic surveys made over 9000 sq. km. The sub-Carpathian Salifère has the most favourable oil prospects, although the locating of test wells is extremely difficult. Surface shows and shows in shallow borings are abundant, but, from the point of view of deep drilling, the region is almost unknown. The presence of the Boryslaw tectonic unit has been proved in the north-west, near Sambor. In the south-east the geology of the area around Niebylow has been elucidated by means of hand-borings and pits, and it is shown that it compares with Bitkow rather than Boryslaw.

Little progress has been made in the anticlinal zone of the Stebnika Beds. The area is free of all surface shows and none were obtained in the test boring—1504 m.—at Gaje-Nizne.

In the Tortonian area it has been shown that the natural gas zones at Königsau, Daszawa, Balicze, Opary and Kosow are associated with the overthrust contact

between Stebnika Beds and the Tortonian. The gas-bearing beds at Kosow are in the form of gentle domes of a size and type not hitherto known in Poland. The investigation of the Tortonian is in its infancy, but it may be said that the Carpathian foreland is very similar to the oil series of the outer Alpine arc, and the Tortonian has all the characteristics of an oil facies. Although the gas at Daszawa is pure methane, in other places it contains as much as 20–30% of ethane and higher homologues. Two problems now to be considered are the search for oil in the Tortonian and the exploration of the older, underlying beds. A further problem is the explanation of the oil shows in the Miocene in the Western Foreland. S. E. C.

229. Discoveries. A. Deussen. *Geophys.*, 1938, **3** (3), 177–197.—Estimates of the oil reserves of the U.S.A. have always proved to be too low and the discovery rate higher than anticipated. Since 1925 no estimates of undiscovered oil have been made because previous figures were so inaccurate, and yet this is the most important aspect of reserves. The Texas–Louisiana Gulf Coast may be taken as a type region for a consideration of this problem. The total number of known structures and fields plotted against time shows that there is as yet no tendency for the curve to flatten and, hence, on statistical grounds, the end of discovery in the Gulf Coast is far off. As another method of approach, a typical oil-producing county in the Gulf Coast, Harris County, is chosen and the production and discovery rates examined. The discovery rate curve for this county is similar to that for the Gulf Coast as a whole and thus, whilst the structures appear to be crowded, it seems that the limit has not yet been reached. In Harris County the area of oil land, assuming all the structures to carry oil, is 4·076%, and so a final figure of 5–6% might be attained. Assuming an average of 1% for the whole of the Gulf Coast and south-west Texas, 461 fields (average 500 acres per field) remain to be discovered. In terms of undiscovered oil this is approximately 9725 million brls. S. E. C.

See also Abstract No. 262.

Geophysics.

230. Reflection of Longitudinal Wave Pulses from Plane Parallel Plates. M. Muskat. *Geophys.*, 1938, **3** (3), 198–218.—A mathematical analysis is made of the reflection of elastic wave pulses from plane parallel plates, the problem being restricted to the case where the incident waves are longitudinal, and the discussion to the reflected wave pulses. The treatment given resolves the reflected wave system into the various individual reflection and refraction processes, and gives the resultant reflection coefficients for the different types in a single step. Further, it shows that the reflected pulses are of the same form as the incident pulse, but are characterized by varying amplitudes and phase shifts. Numerical values are given for the expressions determining the reflection coefficients obtained in the above analysis. These calculations are restricted to the three strongest longitudinal reflected pulses, and the values are represented in graphical form as well as being tabulated. The resultant wave amplitudes, given by the combination of the individual reflected waves, are illustrated graphically for cases where the ratio of the thickness of the reflecting plate to the length of the incident pulse is 2, 1 and $\frac{1}{2}$. S. E. C.

231. Present Status and Future Aspects of Geophysical Exploration in Poland. Z. A. Mitera. *Geophys.*, 1938, **3** (3), 225–233.—The early geophysical work, commenced in 1923, is outlined. Large scale activity commenced in 1934 when the Pioneer Co. formed its own geophysical department. Seismic reflection methods proved to be of very limited application within the Carpathian mountain system, due mainly to the very complex structures, their relatively small size and the definite lack of uniform beds. Conditions are much more favourable in the foreland. Persistent reflections have been followed throughout several thousand square miles and contour maps were made of the reflecting surface. Extensive gravimeter surveys have also been carried out and Schlumberger logging is now standard practice.

It is planned to extend surveys in West Poland for the discovery of salt-domes

similar to the North German type. In the province of Wilno, data is now believed to be sufficient to indicate new oil reserves in Palæozoic and younger sediments associated with the structural uplifts. The structural features may be better outlined by geophysical methods. S. E. C.

232. Second Derivative Contour Method of Interpreting Torsion Balance Data. H. Klaus. *Geophys.*, 1938, **3** (3), 234–246.—Recently the tendency has been to use the torsion balance to measure total gravity, whereas actually it is an instrument for measuring gravity gradients and curvature. It is advocated that these second derivatives should be used in conjunction with a contouring system. In the conventional method they are computed with reference to astronomic north, but in the contour method one of the axes, preferably the y-axis, is taken parallel to the geological strike. Stations should be well spread out over an area, instead of being concentrated along profile lines, and separate contour maps produced of each of the four derivatives. Where very accurate work is being done the contour intervals may be 2–3 E. for the gradient components and 4–5 E. for the curvature components. In other cases, intervals may be 5 E. and 10 E. respectively. The method of interpreting these maps is outlined. It is not advocated that this method be used for quantitative work. Its application lies mainly in the recognition of the types of structure present and their relations to one another. Quantitative work may then be carried out by seismic methods. S. E. C.

233. Transients in Electrical Prospecting. P. F. Hawley. *Geophys.*, 1938, **3** (3), 247–257.—A constant P.D. is applied between two electrodes fixed in the ground some distance apart and the resultant surge of current is recorded. The potential surge between two other electrodes is also recorded. The occurrence of "nicks" in the curves so obtained is said to indicate the presence of different strata below the electrodes. The depth to an horizon is proportional to the time taken for a "nick" to develop and to the resistivity above that horizon. A high-speed, revolving drum camera was used in conjunction with a cathode-ray oscillograph and a special switch gear incorporating a thyratron. The apparatus was mounted in a truck and sufficient cable supplied to enable each current electrode to be spaced 6000 ft. from the truck. The Wenner electrode pattern was used in all voltage transient tests. Field tests were made in the San Joaquin Valley, and details of the results are given. It was found that none of the records shows a "nick" in the wave-front, and that the build-up of the current and potential transients was far too rapid to permit of correlation between the results and the known subsurface conditions. Further tests will be made with modifications of technique. S. E. C.

234. Locating and Detailing Fault Formations by means of the Geo-Sonograph. C. H. Johnson. *Geophys.*, 1938, **3** (3), 273–291.—The normal type of seismograph is handicapped in some regions on account of the confused seismograms which are obtained. This is frequently the case in the vicinity of faults. The cause of the confused records is a multiplicity of waves arriving at the detectors from the neighbourhood of the fault. The method of multiple recording assists to some extent in clarifying the records when confusion is caused by criss-cross waves from depth. If combined detector outputs obtained in this method are plotted as radii vectors, then the envelope of these vectors will be a polar curve which represents the effective sensitivity of the detector group to waves of the reflected wave frequency. The Rieber Geo-Sonograph enables one to rotate this polar sensitivity curve to any desired direction so that one feature may be examined whilst the others are eliminated. This is done by obtaining records of the output of each detector and then combining them, not only in their original phase relationship, but also in any other as desired.

The application of this method of detailing faults is illustrated by three examples. S. E. C.

235. Velocity Determinations by means of Reflection Profiles. C. H. Green. *Geophys.*, 1938, **3** (4), 295–305.—It can be shown simply that to measure the velocity down to any particular horizon, it is only necessary to measure the reflection time for any two different spreads. However, since the relation between X^2 (X = spread) and

T^2 (T = time) is linear, it is recommended that several corresponding values be obtained and the best straight line drawn through the plotted data to average out errors. Although the method is indirect in dealing with second order quantities, it is believed that good reflection data will give results within 3% accuracy.

To obtain such accuracy several conditions must be fulfilled: (*a*) at least one, and preferably several reflections must be known to be continuous over the coverage of the proposed profile; (*b*) weathering must be closely uniform for all the recorder set-ups; (*c*) topographic changes must be a minimum over the several recorder positions; (*d*) all depth shots should be in the same material and at the same approximate depth, so as to minimize the effect of variable shot hole conditions upon reflection reception times, as well as on character and frequency; (*e*) reflecting horizons should be "flat," or at least it is desirable to be able to shoot along the strike. In order to gain the necessary information which will permit the choice of an area complying with the above conditions, preliminary work is necessary which involves the assumption of a depth-velocity relation. By symmetrical disposition of shot and recorder positions, the importance of a "flat" subsurface can be minimized.

Two examples are given with details of the manipulation of the data; and the results are compared with the velocities obtained from shots at the nearest wells. The agreement is good, but it is admitted that the values are inferior to data obtained from wells. G. D. H.

236. Electrical Prospecting with Non-Sinusoidal Alternating Currents. S. S. West. *Geophys.*, 1938, **3** (4), 306–314.—Any non-sinusoidal alternating current, of which the waveform has a sufficiently simple representation in terms of Fourier series, can be used for electrical-resistivity measurements, and should have all the advantages of the transient while being free from many of the practical disadvantages. Such a method bears some resemblance to the transient method, and can make use of its experimental arrangement. The best type of electrode system has four electrodes in a straight line with the detecting electrodes outside the current electrodes. However, this arrangement is not so sensitive as the Wenner system to resistivity contrasts between horizontal strata. A scheme was adopted with the electrodes in a line at 1000 ft. intervals. The detecting and current circuits were therefore 1000 ft. apart. This separation can be altered to meet special circumstances. A 50-cycle alternating current of square form was used. By using a circuit of suitable design one or more cycles of the modified detected wave could be kept stationary on the screen of an oscilloscope connected to the output of the amplifier. The current source was a thyratron relaxation oscillator, controlled by a 50-cycle tuning fork. The average current was 1–2 amp. If the linear electrode system with equal spacings is moved by only a fraction of 1000 ft., the change in the transient can often be easily seen on the oscilloscope screen or its photograph. The same is true for the modified rectangular waveform. A special circuit was designed to measure the changes in the waveform, but it is not entirely suitable for absolute determinations of the waveform.

The theory of the method is briefly outlined. Although the rectangular A.C. does not usually permit the E.M.F. in the detecting circuit to reach the transient steady state, the effect upon each half-cycle is much the same as the effect on the transient, with regard to change of shape. Inasmuch as there exists no mathematical analysis yielding a solution which can predict the shape of the transient or of the modified rectangular wave for any useful cases, it is not very important what quantity is chosen as characteristic of the waveform. It is only essential that this quantity be determined uniquely by the structure of the subsurface, and be sensitive to changes in it. Hence for each prospect fixed values were chosen for all but one of the parameters of the balancing network, and by means of the last the E.M.F. was balanced out from approximately 60° to nearly 180° after the beginning of the half-cycle. The values of this parameter required for balancing the longest possible part of the cycle can then be plotted and contoured. An electrically anomalous closed structure has thus been determined on prospects, some of which have oil. The anomalies may indicate structures in which oil can collect. G. D. H.

237. Resolution of Combined Effects, with Applications to Gravitational and Magnetic Data. T. A. Elkins and S. Hammer. *Geophys.*, 1938, **3** (4), 315–331.—A simple but rigorous and quite general mathematical method is given for finding the minimum

separation of two nearby bodies, at which their observed combined effect indicates the presence of two separate bodies. Geophysical applications of the method are illustrated by investigating the resolution of gravity and torsion balance data for the two limiting cases of spheres and infinite horizontal cylinders, the resolution of the vertical magnetic intensity for infinite rectangular plugs and the direct interpretation of the infinite horizontal rectangular block. The horizontal gradient profile does not satisfy the restrictions imposed by the derivations, and consequently cannot be discussed by this general method. Indeed, the gradient is of little use as a resolution criterion.

If the probable depth of the anomalies in an area to be surveyed is known, the existence of a resolution limit will yield a value of station spacing below which there is no point in going, at least from the viewpoint of detecting individual anomalies. The actual field data will never attain the theoretical resolving power, and allowance must be made for the precision of practical data in applying the above analysis.

G. D. H.

238. The Adjustment of Misclosures. L. G. Cowles. *Geophys.*, 1938, **3** (4), 332–339.—The adjustment of misclosures by the method of least squares is accomplished by solving a system of simultaneous equations which may be written down by inspection of the traverse diagram. The solution of these equations can be effected by measuring currents in an analogous electrical resistance network. The resistances of this network are determined by the geometry of the survey, and the voltages introduced in the loops are proportional to the misclosures. The substitution of the electrical analogy and some simple measurements eliminates the necessity of the laborious calculations required by the method of least squares. The latter otherwise becomes prohibitive in extensive networks. G. D. H.

239. Three-Dimensional Reflection Control. S. M. Rock. *Geophys.*, 1938, **3** (4), 340–348.—A pattern is presented in which ΔT's are obtained from intersecting lines of detectors. Assuming (*a*) plane wave fronts at the detectors, and (*b*) rectilinear wave propagation, formulæ are presented for: (i) ψ, the angle of arrival of the reflected wave in the wave travel plane: *i.e.*, the plane through the line of exploration and perpendicular to the reflecting plane; (ii) θ, the angle between the wave travel plane and a vertical plane through the line of exploration; (iii) α, the dip component in the wave travel plane; (iv) δ, the total dip; and (v) γ, the angle between direction of total dip and the line of exploration.

Application of the method to field work is described and illustrative examples are depicted. G. D. H.

240. Nomogram for Dip Computations. R. Lawlor. *Geophys.*, 1938, **3** (4), 349–357.—It can be shown that the position, strike and dip of a reflecting bed are completely determined by α, θ, T and V where: α = component of dip in wave travel plane; θ = angle between wave travel plane and vertical plane containing line of exploration; T = travel time; V = average velocity of the seismic waves. The chart is applicable to all problems in which geophones are arranged in two mutually perpendicular bisecting lines, an in-line arm with geophones in the line of exploration and a cross-line arm with geophones in a line perpendicular to the line of exploration. If no cross-line arm is used, α is the only dip component determinable. If both lines are used, the chart may be employed to compute α and θ from the ΔT's for any spread, any geophone spread, any travel time and any velocity function provided only that the following assumptions are sufficiently accurate for interpretation of the data: (*a*) The average velocity is a known function of wave-travel time only, and (*b*) the seismic waves travel in straight lines.

The principles underlying the construction of the chart are given. By a simple change of scales it can be adapted to all shot distances, geophone spreads and all wave velocities which are functions of wave travel time only. G. D. H.

241. Geophysical Exploration. S. F. Kelly. *Min. and Metall.*, January, 1939, **20**, 61–65.—A review of geophysical progress and activities in various parts of the world during 1938. In the United States the present trend of gravimetric work seems to be toward

the gravimeter, the number of torsion balance parties showing a considerable decline. The pronounced decrease in seismic crews suggests that the peak in seismic prospecting has been passed in the U.S.A. On the other hand the number of magnetic crews for reconnaissance on oilfield structures shows a slight increase. Brief reference is made to improvements in seismic instruments and to the new mobile electrode for continuous electrical profiling of deep structures. Photographs of some of the latest instruments are shown, including the electrical Echo-Meter which utilizes the principle of sound-wave reflection for ascertaining fluid levels in oil wells. D. W.

242. Stratigraphic vs. Structural Prospecting. E. E. Rosaire. *Oil Gas J.*, 22.12.38, **37** (32), 43.—Each exploratory method was considered the most effective of all, whilst it was operating effectively; but each in turn has experienced the inevitable increase in costs and rapidly diminishing returns enforcing its relegation to oblivion or to a secondary position. A change in exploration technique is only justified insofar as reward is not proportional to effort.

The Gulf Coast salt dome province is examined to illustrate the ideas. The three periods 1901–1924, 1924–1932 and 1932 to date are associated with three major exploration campaigns, each based on the use of one or more distinct exploration techniques: (*a*) Wells were drilled on surface anomalies such as topographic highs and lows, gas seeps and paraffin dirt beds. At first the costs per discovery were low, but they rose. (*b*) Torsion balance and refraction methods followed, and were abandoned when the costs rose excessively. (*c*) The last phase corresponds with the use of the reflection seismograph. Here discovery apparently lags two years behind application. The "difficulty of discovery" and the reasons for rises in costs are analyzed. During the period 1930–1936 the cost per discovery has increased almost fourfold.

Surface geological exploration went through similar phases and was replaced by subsurface geological methods which will, however, persist until all the geological provinces have been exhaustively wildcatted by drilling. It is not so spectacular as the other methods.

Each period of discoveries had more successes than that preceding, but the discoveries were of progressively lower relief.

Structural prospecting methods depend on vertical changes in the sediments; stratigraphical methods depend on lateral changes. The former have tended to be stressed.

The reflection seismograph approaches the drill in penetrating power, but it does not provide such complete information. It is, however, cheaper. The general assumption at the present time is that each new deeper discovery justifies re-shooting the whole Gulf Coast at or a little below that depth. The reflection seismograph is not used to the best advantage in reconnaissance. The same is true of the drill. The reflection seismograph should be developed to yield structural detail in advance of the drill.

There are lateral or stratigraphic changes which result from the underlying structure —induration, mineralization of shallow ground waters, locally increased seismic velocities in shallow sediments, local variations in electrical properties and haloes of leaking hydrocarbons. These evidences are independent of the depth and relief of the underlying structure. Hence the easiest way of discovering structure is to locate such a feature and later to examine it with the reflection seismograph and the drill. Numerous structures of low or zero (true stratigraphic traps) relief have been overlooked by the reflection seismograph. The proper use of stratigraphical methods will serve to locate practically all favourable structures of high and low relief.

The reflection seismograph will continue as a useful tool only to the extent that the observational errors now present remain, or can be made, appreciably less than the relief characteristic of the remaining undiscovered structures. G. D. H.

243. Electrical and Thermal Exploration of Boreholes. L. Migaux. *Bull. Ass. franç. Tech. Pétrol.*, 1938, (45), 4–28.—Electrical coring consists essentially in making continuous records of resistivity and spontaneous polarization. The resistivity recorded as the electrodes pass down the hole is not the true resistivity of the formations traversed, but an apparent resistivity which includes factors due to the presence

of the drilling mud, etc. For ordinary correlation purposes this apparent resistivity is sufficient. Spontaneous polarization is due principally to electro-filtration and electro-osmose phenomena. In order to separate resistivity measurements from spontaneous polarization measurements, an A.C. supply is connected to the current electrode. Two P.D.'s are thus superimposed and picked up by the measuring electrodes, one, alternating, which measures the resistivity, and one, continuous, which measures the spontaneous polarization. These are separated and recorded independently. The magnitude of the spontaneous polarization gives a measure of the permeability of the strata. An oil-sand gives high spontaneous polarization and resistivity, whilst a water-sand gives high spontaneous polarization and low resistivity. Strata such as dense limestones give low spontaneous polarizations and high resistivities.

It has been found that the conductivity of strata is always greatest in the direction parallel to the bedding and the equipotential surfaces are ellipsoids. By using two sets of measuring electrodes at right angles to each other, and symmetrically placed with respect to the centre of the borehole, the shape of this ellipsoid may be determined, and hence the direction of dip of the strata. The electrodes are orientated by means of the magnetic compass, and a teleclinometer is also run with the instrument, so that corrections may be made for deviation of the borehole from the vertical. A set of measurements is made at intervals of 10–20 cms. in order to reduce the effect of small local anomalies.

Continuous temperature measurements in a borehole are made with an electrical resistance thermometer. The temperatures obtained when the borehole fluid is in thermal equilibrium with the strata, give useful data to the engineer and also show the junction between strata of widely differing thermal conductivities. Measurements made before thermal equilibrium is complete indicate the points of entry into the well of water and of oil and gas. Electrical coring is impossible in cased wells and temperature surveys are the only means of getting information. The temperature diagram is comparable with the resistivity–porosity diagram, although the details are far less well defined. The thickness and position of cement are clearly shown if a temperature survey is made several hours after completion of the cementing operation.

S. E. C.

244. Work of the State Geophysical Survey in German Petroleum Areas. H. Reich. *Oel u. Kohle*, 1939, **15**, 23–26.—An outline is given of the progress of the State Geophysical Survey (which is stated to have already yielded very valuable results) under four headings: gravimetric measurements, torsion balance measurements, seismic measurements and magnetic measurements. For technical reasons, the work done in Austria is not included, though it is stated that a considerable amount has been carried out.

Maps are given showing the areas already covered under the four headings in the old Reich, the gravimetric and magnetic surveys being most advanced. Examples are quoted showing that each method is liable to give apparently conflicting data, and insistence is placed on the difficulty in correctly interpreting the results. For this purpose a knowledge of geology as well as geophysics is necessary, and the author stresses how essential it is that all geophysicists should also be geologists, and *vice versa*.

T. T. D.

Drilling.

245. Control of Heaving Shale by Blasting. F. R. Cozzens. *Petrol. Engr*, December, 1938, **10** (3), 46.—Waxy shales that behave much like quicksands are encountered at about 600 ft. in the Ohio, West Virginia and Kentucky fields. The moment an opening is made the walls slip and crumble. The thickness of the shale ranges from 30 to 70 ft.

Explosives are being used in some oil-producing districts to control the grainless shales. It is found that instead of crumbling the walls the force of the blast stiffens them, permitting drilling to proceed without interruption.

A torpedo was made from an 8-ft. section of metal rain pipe, closed at the bottom and provided with a bail in the top. Twelve cartridges of ammonia dynamite, 40%

in strength, were loaded into the shell. Into the top cartridge was inserted a No. 6 electric blasting cap, which was connected by an insulated copper wire sufficiently long to reach to the firing battery.

The charge was fired and the débris was removed by a suction bailer. Drilling was continued for a further 15 ft. and a second torpedo containing ten cartridges was then exploded. The walls stood up until the casing was set.

The principle is to stem the charge in such a manner that sufficient force is exerted against the side walls to make them firm and sear them for a short time.

L. V. W. C.

246. World's Longest String of 9⅝-in. Casing Set. K. C. Sclater. *Petrol. Engr*, January, 1939, **10** (4), 21.—The longest string of 9⅝-in. casing ever to be run in a well has recently been set in the Gulf Coast. This string weighed approximately 253 tons at a depth of 11,631 ft.

The well is situated in the shallow water on the Louisiana Coast and is being drilled from the Texas Company's specially constructed submersible barge, on which is mounted the derrick and the drilling rig, steam being used as a source of power.

Extreme care was exercised in conditioning the mud and before pulling the drill pipe the weight of the mud was 11·1 lb. per gal. viscosity 51° A.P.I., sand content 2%, salt 3150 parts per mil., temperature at flow line 123° F., and solids 37% by weight.

The casing was set in less than 24 hrs., and with no serious trouble.

L. V. W. C.

247. Under-reaming Reduces Cost of Drilling and Deepening Wells in California. W. R. Roulston. *Petrol. Engr*, January, 1939, **10** (4), 27.—The Montebello field in California is underlain by an unknown number of possibly productive deep zones. Deepening is an advantage in some wells producing from upper formations. When production from upper formations is disappointing under-reaming has been used successfully and has saved a considerable amount of money in the cost of drilling and completing the well.

A hole that is under-reamed to provide clearance for the largest liner that will pass through the casing will permit the use of smaller water strings and surface pipe and, therefore, smaller bits from the surface to the total depth of well. L. V. W. C.

248. Chemical Control of Heaving Shale. C. L. Baker and A. D. Garrison. *Petrol. Engr*, January, 1939, **10** (4), 50.—Heaving or caving of the hole has prevented deep drilling in certain areas. This phenomenon may result from the establishment of a serious pressure differential in the hole or from hydrous disintegration of "heaving shale." This heaving can be avoided by using a drilling mud rich in silicate of soda and sodium chloride. The requirements in such a mud, its formulation and use in the field are discussed with a brief description of the equipment required and special problems that must be met. Heaving due to hydrous alteration of shale has been prevented when drilling has been carried out using this new method. L. V. W. C.

249. Improvements in Methods of Gravel Packing Oil Wells. W. A. Sawdon. *Petrol. Engr*, January, 1939, **10** (4), 95.—The general method of gravel packing in use in California is the reversed circulation method. Most of the gravel packing has been done in new wells, although in the Bakersfield area gravel has been used to repair a few wells.

In the two general practices now being followed, using the reverse circulation method, the gravel is carried in a mud fluid down the annular space between the casing and the tubing on which the liner is run and supported during the operation. When the fluid and gravel reach the liner they continue downward outside the liner. The gravel builds up around the liner and the carrying fluid enters the liner at the bottom returning to the surface through the tubing.

Centralizing guides aid materially in distributing the pack uniformly around the liner.

An adjustable nipple and gravel-mixing trucks are recent developments.

L. V. W. C.

250. Drilling with Reverse Oil Circulation in Wider Use. E. J. Beckman. *Oil Wkly*, 5.12.38, **91** (13), 19.—Considerable work has been done during the last two years in developing the reverse circulation method of drilling. With this method it is possible to (i) drill new wells, (ii) drill, plug and wash well, (iii) drill out cement plugs, (iv) underream while drilling, (v) underream and drill new holes in salt water disposal wells, (vi) clean out wells quickly and (vii) perform special jobs such as rolling out collapsed casing, side tracking, etc. Many advantages are gained by its use.

The method is simply rotary drilling using a pack-off head at the top of the casing in order to circulate the drilling fluid in the reverse direction of conventional methods.

Accurate logging can be accomplished, and the velocity of the fluid up the drill pipe is greater than is possible with the normal method, and a sample of the cuttings for observation is available in much less time. L. V. W. C.

251. Rotary Conquers Michigan's Traverse Lime. N. X. Lyon. *Oil Wkly*, 12.12.38, **92** (1), 17.—The first deep well in Michigan to be drilled by rotary has recently been completed and has shown a marked saving in drilling time over cable tools. No special drilling muds were used, and a density of 9·7 of 0·3 viscosity was carried on this test. L. V. W. C.

252. Survey of Cementing Jobs to Shut off Salt Water in East Texas. P. Montgomery. *Oil Wkly*, 12.12.38, **92** (1), 34.—This article is an account of the various types of cementing jobs used to shut off salt water in the east Texas oilfield.

These jobs are classified into four groups with a total of twelve different types or methods and each is dealt with in some detail.

As a result of this investigation it may be stated that :

1. The method best adapted to the conditions should be used. There is no one kind of job that can be recommended for any and all wells.
2. In wells making a high percentage of salt water, retainer squeeze and short-string squeeze jobs are recommended.
3. The retainer squeeze job will be most used owing to the light-weight casing used.
4. The braden head squeeze job has been successful where the cement job is done shortly after the well has started to make salt water.
5. High-pressure squeeze jobs will be much more permanent.
6. Slow setting gel-forming cements have assisted considerably in improving the method of shutting off salt water. L. V. W. C.

253. Care and Maintenance of Instruments Used on Drilling Rigs. E. L. Decker and N. L. Dorn. *Oil Wkly*, 19.12.38, **92** (2), 42.—Drilling crews are unprepared to handle the instruments necessary to progress with the advances made in rotary drilling technique.

This article brings out the need for care and maintenance routines, and reports are quoted to show the benefits to be gained from such programmes. Fixed responsibility, instruction of crews and steps to minimize the occurrence and effects of abuse are recommended. L. V. W. C.

254. Drilling Patents. A. G. Loomis. U.S.P. 2,143,990, 17.1.39. Appl. 27.11.34. A method of differentially shutting off water in oil wells penetrating both oil and water without permanently hindering the flow of oil into the well, consisting of the use of two aqueous solutions, the first containing an acid and the second a reagent, which on admixture with the acid, reacts to form a water-insoluble, oil-soluble plastic. The plastic is caused to form in the interior of the water formation.

A. G. Loomis. U.S.P. 2,143,991, 17.1.39. Appl. 27.11.34. A method of shutting off water in brine-bearing formations which comprises injecting into the formations in liquid form a water-soluble soap of the polycyclic naphthenate type, the calcium and magnesium derivatives of which are soluble in oil. The soap is caused to mingle with the brine in the brine-bearing formations to form insoluble sealing deposits.

J. J. Bishop. U.S.P. 2,144,100, 17.1.39. Appl. 11.2.36. Rotary jar.

C. C. Taylor. U.S.P. 2,144,669, 24.1.39. Appl. 16.3.35. Bailer having means for opening the valve controlling the discharge port.

J. W. Pippin. U.S.P. 2,144,687, 24.1.39. Appl. 4.1.37. Drilling apparatus comprising a tubular drill stem, an assembly adapted to be lowered through the stem and including a drilling cutter pivoting about a transverse axis. Means provided for actuating the cutter into transverse position to engage the lower end of the stem upon upward movement of the assembly.

J. M. Kendall. U.S.P. 2,144,762, 24.1.39. Appl. 29.9.37. Recording thermometer for use in boreholes comprising a casing, a plug closing one end of the casing, a heat-insulating tube, a bulb attached to the free end of the tube, a coil of Bourdon tubing, having one end closed and the other fixed to the plug, and means for recording the movement of its free end and a supply of volatile liquid in the bulb.

E. F. Raymond. U.S.P. 2,144,810, 24.1.39. Appl. 27.4.35. Adjusting device for drilling jars.

G. M. Boulter. U.S.P. 2,144,869, 24.1.39. Appl. 20.3.36. Rotary jar.

H. R. Standlee. U.S.P. 2,144,944, 24.1.39. Appl. 18.1.37. Well swab.

R. Flagg. U.S.P. 2,145,168, 24.1.39. Appl. 21.10.35. Method of treating threaded pipe connections to obtain a leak-proof lock connection.

W. G. Frenzel. U.S.P. 2,145,170, 24.1.39, 30.1.36. Core barrel.

H. Pennington. U.S.P. 2,145,191, 24.1.39. Appl. 16.7.29. Core barrel which can be retrieved by means of circulating fluid.

H. Pennington. U.S.P. 2,145,192, 24.1.39. Appl. 12.1.37. Tubing catcher sub for use with retrievable core barrel. L. V. W. C.

Production.

255. Use of Gas Lift in Handling Small Allowables. S. F. Shaw. *Oil Wkly*, 19.12.38, **92** (2), 38.—Gas lift has now become a popular method of handling small allowables in many fields and entails a low capital expenditure per well for installation of equipment, and reduces the lifting cost to a low point.

In new fields the method is favourable for the following reasons: (1) where high flowing pressures are available, high fluid levels are found; (2) gas oil ratios obtain that are at least as high as those originally associated with the oil before the reservoir was tapped; (3) small allowables require low cost equipment; (4) centralized machinery may be installed; and (5) infrequency of pulling and other well jobs. L. V. W. C.

256. Measurements of Rates of Gas Delivery Under Conditions of Non-Critical Flow and Critical Flow. B. Altman. *Oil Wkly*, 26.12.38, **92** (3), 24.—The instruments most commonly used in calculating open flow of gas-wells are: pitot tube, choke nipple, critical flow provers, the back pressure method, funnel meter, orifice well tester and orifice meters. The first quoted four methods are suitable for critical flow measurements, whilst the remainder are suitable for non-critical flow. The funnel meter is better adapted to use on small wells, since the maximum rate of flow that can be measured with it is 8,000,000 cu. ft. per day.

The uses of each of these instruments is explained in detail, and diagrams are given of a number of them. L. V. W. C.

257. East Texas Experiment Shows Feasibility of Returning Salt Water to Producing Formation. H. H. King. *Oil Wkly*, 28.11.38, **91** (12), 23.—Input wells situated on the water drive flank of the east Texas field may be used to take the huge volume of salt water that must be handled in draining this field.

Steps are being taken to instal input wells in order to be prepared when the produc-

tion of brackish water can no longer be accommodated in the surface pits. Facilities for treating the water to cleanse it of foreign compounds that would clog the exposed sand have enabled 3000 brls. of water daily to be returned to the input well already in existence. The brine flows by gravity from a gun barrel through a baffle tower and thence to a receiving tank. The water is delivered to a filter box above the tubing head on the well.

Experiments are now under way to coagulate the fine particles of foreign matter carried by the brine to accomplish greater precipitation and at a faster rate. Tests are to be made with slaked lime and, also, chlorine. L. V. W. C.

258. Salt Water Disposal System in the Fitts Pool. J. C. Albright. *Petrol. Engr*, December, 1938, **10** (3), 66.—A mutual co-operative association has been formed in the Fitts Pool to deal with the quantity of salt water being produced in the field.

The first salt water produced was collected in large reservoirs and pools and permitted to soak into the soil and to evaporate into the atmosphere. Fear of polluting the streams impelled the operators to develop the disposal system.

Core analysis of all the formations indicated that water could be pumped into the Wilcox and Oil Creek sands in large quantity, if filtered.

A gravity drainage system to transport the brine to a central reservoir was next designed.

About 11,000 brls. of brine per day are pumped at a pressure of about 250 lb. No pressure build-up has been noticed showing that filtration has clarified the water sufficiently that the sand face is not plugged to any noticeable extent.

L. V. W. C.

259. Gas Lift Project in East Texas Utilizes Gas from Distillate Well. J. W. Lee and F. H. Love. *Petrol. Engr*, December, 1938, **10** (3), 74.—The gas from a wildcat high-pressure well has been piped to a nearby field for gas-lift purposes. This gas, which would otherwise be virtually useless, is made to produce oil economically.

The gas is separated from the distillate and metered before entering the line. The well pressure, which is 1000 lb., is reduced to 350 lb. at the injection well by means of high-pressure regulators. The gas is injected into the annular space between the tubing and the casing.

Flow valves are an important feature, and from five to eight valves are installed in the tubing string at intervals ranging from 200 to 350 ft., the top valve at about the static fluid level. L. V. W. C.

260. Effects of Surface Phenomena on the Production of Oil. H. K. Livingston. *Petrol. Engr*, January, 1939, **10** (4), 84.—This article describes an investigation of surface phenomena of liquids and solids, and shows that interfacial tensions appreciably affect the rate of movement of fluids in the reservoir. L. V. W. C.

261. Determination of the Potential Productivity of Oil-bearing Formations by Resistivity Measurements. M. Martin, G. H. Murray and W. J. Gillingham. *Geophys.*, 1938, **3** (3), 258–272.—The resistivity of an oil-sand depends on the amount of saline water in the sand. It has been observed that this may be as high as 30%, even in the case of a sand producing pure oil. Resistivity measurements were made in the laboratory on sands in which there were varying proportions of salt water and oil. It was found that the curve relating electrical resistance to oil content did not rise steeply until the percentage of oil was approximately 80%. Thus, rich oil-sands may have a comparatively low resistance and, furthermore, large variations in resistance are associated with only small changes in oil saturation. This relationship enables one to obtain a measure of the oil saturation of a sand, provided its true resistivity can be measured. In electrical logging apparent resistivity is obtained and this is not sufficiently accurate for the present purpose. By making measurements opposite the same bed with successively increased electrode spacing, apparent resistivity may be plotted against electrode spacing. From the curve so obtained the true resistivity of the bed may be obtained. Experience has shown that only a few of these curves need to be drawn for a given district in order to determine the

best electrode spacing. All other determinations of true resistivity in the district are then single measurements at that spacing. The method can be used only for beds of greater thickness than 10–15 ft. S. E. C.

262. Application of Physico-chemical Principles to the Investigation of the Properties of Rocks. Part III. Comparison of Methods and Conclusions. A. H. Nissan, C. E. Wood, L. V. W. Clark and A. W. Nash. *J. Instn Petrol. Tech.*, 1938, **24**, 585–597.—The two methods for determining porosity described in Parts I and II are compared and the overall accuracy of each method is calculated and demonstrated experimentally. D. L. S.

263. Gas Lock Protective Devices and Mobile Rotary Pumps Used on K-M-A Gathering Systems. J. C. Albright. *Oil Wkly*, 2.1.39, **92** (4), 21.—The design of the gathering system of the Texas Pipe Line Co. in the K-M-A field of north Texas and the use of mobile rotary type pipe line pumps has enabled the Company to move a much greater amount of oil than is ordinarily possible.

All pipe line companies at K-M-A have built gravity systems as far as practicable, but because of the gassy characteristic of the oil, oil firms are faced with gas locking in their systems. In addition air in the feeder lines from the tank batteries is as troublesome as the gas.

The conventional method of handling oil is to allow gravity to move the oil as far as practicable. At the station side of the lines pumps are frequently used that pull a high vacuum on the oil in an attempt to accelerate the movement of oil. K-M-A crude makes this almost impossible, for when this is attempted the oil invariably breaks into gas pockets. Automatic air release and vacuum valves have been installed. By slowing down the permanently installed pump and by having a slight head on the intake the oil would move faster from the batteries than if a good vacuum was pulled.

Mobile rotary pump units have been developed. The pump is mounted on a light maintenance truck, power being taken from the transmission take-off of the truck. L. V. W. C.

264. High Pressure Gas From Another Field Flows East Texas Wells. Anon. *Oil Wkly*, 2.1.39, **92** (4), 26.—High pressure gas is being transported a distance of about ten miles in the east Texas field for the purpose of gas-lifting production. A six-mile branch is run to other properties where four different makes of gas lift valves or intermitters were tried in a number of wells.

The gas from the gas well had an initial pressure of 2770 lb. at the well and is carried to the other properties at 750 lb. after it has been passed through a separator.

A recent survey shows that over 100 wells are now operating on gas lift from this source. L. V. W. C.

265. Fluid Level Indicator is Useful in East Texas Field Operations. G. Weber. *Oil Gas J.*, 15.12.38, **37** (31), 44.—A number of new methods for testing and equipping wells in which natural flow has ceased have been introduced in the east Texas field due to the increased use of artificial lift. Knowledge of fluid levels, bottom hole pressure, build-up and other characteristics are needed in fitting the well for best results in secondary production.

The new procedure employs the use of sound wave reflections to determine the depth of the fluid level in the well tested.

Equipment for conducting tests of this type comprises a heavy duty well-head connection incorporating a gun and a sensitive microphone, an amplifier equipped with tuning and filtering provisions and a pen recorder.

Since speed of sound varies in different wells, depending upon the density and characteristics of the gas medium in the column, depth determinations are greatly simplified by using the tubing collar reflections for depth calibrations. The average tubing length is derived from well records, and by direct measurement on the ribbon, of a length including a certain number of tubing collar reflections, the basis for the calculations is established. L. V. W. C.

266. Magnolia Water Project Represents Advance in Disposal Technique. P. Reed. *Oil Gas J.*, 22.12.38, **37** (32), 30.—Several unique features are included in Magnolia

Petroleum Co.'s salt water disposal project in the Fitts Port, Oklohoma. Among the more important are: (i) ample provisions for separating oil from brine before it reaches the treating plant; (ii) provisions for cleaning lines by pumping scrapers through the lines while operating under pressure or by gravity flow; (iii) gathering lines with provisions for increasing delivery capacity; (iv) the pipe in the gathering lines is of material that will not be corroded by either salt water or the soil; (v) the line is maintained at a definite gradient throughout; (vi) additional connections may be made at any time; (vii) reservoir storage is much smaller than usual; (viii) treating plant is flexible; (ix) the disposal well will take large quantities of water under low pressures and should continue to do so for a long period; and (x) the equipment is such that a high percentage can be salvaged when necessary. L. V. W. C.

267. Production Patents. C. T. Anderson. U.S.P. 2,143,836, 17.1.39. Appl. 30.8.37. Gas anchor.

G. T. Humphrey. U.S.P. 2,143,945, 17.1.39. Appl. 2.11.36. Crank for well pump.

B. H. Stone. U.S.P. 2,143,962, 17.1.39. Appl. 14.12.36. Subterranean fluid flow measuring device, in which packing means are available to produce non-flow and open-to-flow areas. Plurality of meters within the device to measure the flow of fluid into the well from each open-to-flow area.

T. S. Park. U.S.P. 2,144,026, 17.1.39. Appl. 6.2.36. Well packer.

W. F. Cox. U.S.P. 2,144,045, 17.1.39. Appl. 16.10.36. Well pump.

J. C. Hewitt, Jr., and V. E. Kuster. U.S.P. 2,144,061, 17.1.39. Appl. 15.2.35. A well-surveying apparatus comprising a catcher placed in a fixed position with a whipstock fixed in known orientation with the pipe. A well-surveying instrument is lowered into the drill pipe to a fixed position of rest with the catcher. Means provided for indicating the oriented position of the instrument within the casing.

C. C. Crickmer. U.S.P. 2,144,144, 17.1.39. Appl. 5.10.35. Means for raising liquid from wells.

A. J. Penick and K. T. Penick. U.S.P. 2,144,227, 17.1.39. Appl. 14.2.36. Combination well-head and hanger.

A. J. Penick and K. T. Penick. U.S.P. 2,144,228, 17.1.39. Appl. 16.7.36. Control valve mechanism for well-heads.

J. R. Davidson. U.S.P. 2,144,403, 17.1.39. Appl. 28.10.38. Oil saver.

F. A. Thaheld. U.S.P. 2,144,420, 17.1.39. Appl. 21.3.36. Well packer.

A. Anderson. U.S.P. 2,144,422, 17.1.39. Appl. 7.8.35. Survey apparatus for taking photographs of the hole at any desired point.

F. Stone and G. S. Knox. U.S.P. 2,144,818, 24.1.39. Appl. 23.5.36. Well-pipe plug.

C. C Crickmer. U.S.P. 2,144,833, 24.1.39. Appl. 2.11.36. Well flowing apparatus.

D. Hanes. U.S.P. 2,144,842, 24.1.29. Appl. 27.4.37. A packer adapted to be used in a bore hole and means for setting and releasing it in a well.

B. Nay. U.S.P. 2,145,190, 24.1.39. Appl. 24.5.38. Swivel joint hard oil remover for tubing strings. L. V. W. C.

Transport and Storage.

268. Oil Meters. L. G. E. Bignell. *Oil Gas J.*, 5.1.39, **37** (34), 39.—Oil meters for metering crude oil and its products have been developed within the past few years. These can be grouped into two general types and classified as quantity meters or rate-of-flow meters and rate meters.

In the quantity-meter class there are two types—positive meters and inferential

meters. In the first the flow is divided automatically into separate isolated parts equal by weight or by volume. In the inferential meter the flow is "inferred" from the action of the stream on the primary element of the meter.

Current meters may also be divided into two kinds, the free impeller type and the confined impeller type. In the first class the impeller is placed in the centre of the cross-sectional area of the conduit, whilst in the second the casing is so arranged that all the liquid, after passing through straightening vanes, is forced through the impeller.

There is also a weighing type of meter. Volume-type meters may be classified into mutating-disc, oscillating-piston rotary and piston meters. L. V. W. C.

269. Correlation of an Electrolytic Corrosion Test with the Actual Corrosiveness of Soils. I. A. Denison and R. B. Darnielle. *Bur. Stand. J. Res., Wash.*, 1938, **21** (6), 819–830.—The electrolytic test for measuring the corrosiveness of soils consists in determining the polarization voltage at various current densities of a specially designed cell in which the electrodes are steel and the electrolyte is the soil under test.

The corrosiveness of soils along a 128-mile section of a pipe-line system was estimated from data on the occurrence of leaks and length of line reconditioned and from the results of the electrolytic corrosion test.

It appears that this corrosiveness decreases as drainage improves and increases as the soils become heavier in texture.

It was found that a rough linear correlation existed between the actual corrosiveness of the soils and the results of the laboratory electrolytic test. D. L. S.

Crude Petroleum.

270. Chemical and Refining Study of some Wyoming Black Oils. H. M. Thorne and W. Murphy. *U.S. Bur. Mines. Rep. Invest. No.* 3423. November, 1938.—In general these crude oils are characterized by their high sulphur, high asphalt and low gasoline content, and are called black oils because of these properties and their colour. Crudes from Oregon Basin, Dallas-Derby and Garland Fields have the following properties: sp. gr. 0·924–0·940, sulphur content 2·89–3·25%, viscosity S.U. at 100° F. 260–530 secs., pour pt. below — 5° F., carbon residue 8·0–10·2%. The demand for the crudes is at present largely controlled by the requirements of asphalt and road oil products in the market territory. With a view to increasing possible outlets for the crudes, cracking studies have been conducted at the Laramie station on topped crudes under different conditions of pressure and temperature, and the refining of light distillates to market standards examined. The straight-run naphthas produced by topping (10–18% yield) are deficient in light fractions, high in sulphur content and low in octane rating (31–34). They therefore require blending with suitable naphthas or to be "reformed" or cracked and subsequently treated. Cracking of the topped crude in a special laboratory batch equipment yielded naphthas having octane ratings of 48–61, according to the temperature and pressure utilized, of good volatility but containing about 1% of sulphur in all cases. Optimum yield of cracked naphtha based on crude is about 45%. Refining by acid to sulphur content of 0·1% requires excessive quantities of acid and lowers the octane number of the cracked gasolines appreciably. A more complete investigation of the refining problem is planned. Approximately one third of the sulphur in the crude was converted to H_2S, which may be removed and converted to acid. Considerable quantities of non-condensible gases were produced, and the yield of coke was usually about 25–30%. The sulphur content of the coke was usually about 5% or more, which will cause little difficulty for fuel purposes, but may be detrimental for certain metallurgical purposes. As a result of the work so far conducted it is proposed to investigate the alternative method of producing specification asphalts from the crudes and cracking the intermediate distillates. The crudes are particularly well suited to the manufacture of road-binding materials and other asphaltic products on account of their high asphalt content. R. A. E.

271. Refining Value of Foreign Crudes. G. Egloff, J. C. Morell and G. B. Zimmerman. *Oil Gas J.*, 29.12.38, **37** (33), 74.—Analyses and yields from laboratory distillation of the following crudes are given:

(1) Poza Rica, Mexico.
(2) Colombia (high cold test and low cold test).
(3) Turner Valley (44·0° and 49·2° A.P.I.) and Wainwright, Alberta.
(4) Oil from Alberta Tar Sands.
(5) Comodoro, Argentina.
(6) Gbely (Egbell), Czechoslovakia.
(7) Lispei and a 50/50 blend of Lispei and Bukkszeki, Hungary.
(8) Dhulian, Brit. India. C. L. G.

272. **Laboratory Method for Evaluating Crude Oil, with Special Reference to Trinidad Crude.** R. G. Johnstone and R. Palmer. *J. Instn Petrol. Tech.*, 1938, **24**, 605–620.—A laboratory procedure is described for evaluating crude oil in terms of three fractions—gasoline, gas oil and fuel oil. D. L. S.

273. **Patent on Crude Oil.** C. S. Cerf. U.S.P. 2,140,574, 20.12.38. Appl. 16.8.37. Process of desalting crude oil. W. S. E. C.

Gas.

274. **Patent on Gas.** De Directien Van de Staatsmijnen and C. Otto & Co. E.P. 497,330, 14.12.38. Appl. 14.6.37. Removal of H_2S from gases by means of an ammoniacal solution containing Fe compounds, which is regenerated by means of O_2 after washing. W. S. E. C.

Cracking.

275. **85% of Gasoline of 81 Octane (number) from Gas Oil.** W. T. Ziegenhain. *Oil Gas J.*, 8.12.38, **37** (30), 23.—A semi-commercial scale catalytic cracking unit in operation at the research plant of the Universal Oil Products Co. can produce 85% of gasoline of 81 octane number from Mid-Continent gas oil of A.P.I. gravity 36·7°, I.B.P. 407° F., F.B.P. 750° F., Visc. S.U. at 100° F. 40 secs. The gasoline produced is stable in respect of colour and octane rating and has a vapour pressure of 10 lb. The yield of gasoline is based upon a recycle operation, and includes that obtained from catalytic polymerization of the cracked gases. The plant consists essentially of a heater, two banks of catalyst reactors, and automatic controls for alternating the flow of heated oil first through one half of the reactors and then through the other half whilst the catalyst in the first is being reactivated. Reactivation is accomplished by purging the reactors of oil vapours, and burning off the carbon which collects on the catalyst by passing a predetermined amount of air through the tube maintaining a moderate temperature of combustion. Twenty types of charging stocks, ranging from residues to gas oils, have been investigated in selecting the most practicable catalyst which showed practically complete recovery on reactivation over long periods of time in laboratory tests. Highly paraffinic overhead distillates are the most suitable feed stocks. R. A. E.

276. **Determination of Yield per Pass, Time of Treatment and "In Situ" Density and Instrumentality for their Control in Commercial Cracking Units.** R. L. Rude, R. D. Jenkins and C. Barnes. *Refiner*, November, 1938, **17** (11), 583.—It is now recognized that the time-temperature relationship is the most important of the conditions governing the yield of a cracking unit and that the properties of the material in any section of the unit must be known with a minimum of delay. A change in properties necessitates a change in plant conditions if the properties of the final product are to remain unchanged. It has been established that the density of the material can be used as an accurate guide of its relevant properties, and instruments have been devised for the determination of densities "in situ," that is continuously and without recourse to the withdrawal of samples. There is thus no time lag in the production of information. The density measuring device is described in great detail. It consists of an orifice

connected to a differential head meter. The weight rate of flow of a fluid passing through a pipe and orifice of known design can be expressed thus :

$$W = 0{\cdot}0997 \frac{CD^2}{\sqrt{1-\beta^4}}\sqrt{dh_w}$$

where W = rate of flow in lb. per sec., C = coefficient of discharge, D = diam. of orifice in in., $\frac{1}{\sqrt{1-\beta^4}}$ = approach factor, h_w = differential head in in. water, d = density of the flowing fluid, in lb./ft.^{3}. The time of detention of a fluid in a zone of known dimensions can be calculated thus

$$t = c\frac{md \,.\, V}{W}$$

where t = time of detention, md = mean density of the fluid, V = vol. of the zone, W = weight rate of flow and c = constant. H. G.

277. Cracking Pennsylvanian Gas Oil for 90 O.N. Blending Value Gasoline. A. L. Foster. *Nat. Petrol. News*, 14.12.38, **30** (50), R. 594.—In the cracking of Pennsylvanian gas oil by the True Vapour Phase Process considerable improvements in yield and octane number have been achieved by recycling the gas discharged by the compressor–cooler system and made up of gas from the gasoline accumulator and stabilizer top. Part of this gas is passed into the cycle gas heater and part is sent through a " flash gas " heater coil into the flash drum to aid in the vaporization of the charge. There is indirect evidence that an appreciable proportion of this gas is polymerized. The total yield is 67% on the gas oil, which brings the total yield from the crude to 82%. The final reformed product has an octane number of 75 and a blending octane value of 90. The raw gasoline is sweetened in a continuous doctor treater, washed with water, sodium bisulphite solution, water again, filtered through a sand bed and finally treated with inhibitor. The plant produces some 820,000 cu. ft. daily of polymerizable hydrocarbons, which, so far, are not utilized except, in part, as fuel. H. G.

278. Patent on Cracking. E. J. Houdry. U.S.P. 2,141,185, 27.12.38. Appl. 27.4.35. Process of reforming naphtha in order to increase the anti-knock quality. W. S. E. C.

Hydrogenation.

279. Hydrogenation as a Step Towards Italian Oil Autarchy. Anon. *World Petrol.*, 1939, **10** (1), 56.—A hydrogenation plant has been put into operation at Livorno, Italy, a second is under construction at Bari and a third may be added later to handle Albanian crude oil. It is proposed eventually to substitute to a large extent imported Iraq oil by this crude and oils from Italian asphalts, shales and lignite tars. The Livorno refinery also contains distillation units, a cracking unit and a solvent treating plant. The hydrogenation unit operates under the Bergius patents giving a yield of 80% of gasoline from the Albania crude, which is highly sulphurous and yields only 12% of straight-run gasoline. It will also be used to produce 60,000 tons of high quality lubricants and in addition iso-octane. The two plants will produce 240,000 tons of automobile and aviation gasoline—half the national consumption—but this may eventually be increased to 400,000 tons.

Storage facilities at Livorno are equipped with a nitrogen circulation system for fire protection, while the electric power plant utilizes the energy produced through the boracic *soffioni* of Larderello. The completion of the Venice and Trieste refineries and the curtailing of domestic consumption of gasoline to 340,000 tons per annum enables considerable quantities to be exported. The potential production of the Albania wells is given as 120,000 tons and that from domestic lignite as 170,000 tons, and that from calcareous asphalts, bitumens and schists as 100,000 tons. Italian crudes yield 5000 tons of gasoline, while a quantity equivalent to 12,000 tons is obtainable by the use of natural gas, and a quantity equivalent to 85,000 tons by

the use of solid fuels. Production of alcohol for compulsory admixture with gasoline has been suspended owing to an inadequate sugar-beet crop and its low sugar content. Benzol production has been increased from 17,000 tons in 1937 to 22,000 tons in 1938. Italian imports of refined products were reduced by 40·6% during 1938, the Italian refineries being now capable of meeting the entire gasoline demand, 65% of the agricultural and illumination oil, 75% of the lubricating oil and 100% of the white spirit, transformer oil and asphalt demand. C. L. G.

280. Mean Pressure Synthesis of Paraffins from CO and H with a Co Catalyst. F. Fischer and H. Pichler. *Brennst.-Chemie*, 1.2.39, **20** (3), 41–48.—Hydrogenation tests have been carried out at temperatures and pressures intermediate between those of the normal pressure gasoline synthesis and those of the high-pressure methanol synthesis. This "mean pressure synthesis" differs basically from hitherto known processes. Similar to the gasoline synthesis CO and H are consumed at a ratio of approximately 1 : 2. Using a Co catalyst optimum conditions are 160–200° C., and 4–20 atm. Maximum yield is obtained near the lower temperature limit. With the same Co catalyst as used in the gasoline synthesis optimum temperatures of the mean pressure synthesis are lower. At the pressures prevailing in the mean pressure synthesis and using Co catalysts, maximum yield of solid paraffin, which is the main product of the reaction, and also maximum total yield, is obtained. At the same time catalyst life was longest. Exceeding the pressure region of the mean pressure synthesis resulted in no advantage. Operating in one stage with the same catalyst and without catalyst reactivation a solid paraffin yield 6–7 times that of the gasoline synthesis was obtained, paraffins boiling over 450° C. were up to twenty-five times more, whereas total yield of liquid and solid hydrocarbons was 25–30% higher. The life of the catalyst was six times longer than in the normal pressure synthesis.

It is concluded that, contrary to previous opinion, high molecular hydrocarbons do not possess a greater tendency to reduce the activity of Co catalysts. The more rapid decline of catalyst activity in the normal pressure synthesis is explained by the formation of minute quantities of compounds of adverse effect on the catalyst, whereas such compounds are made harmless in the mean pressure synthesis by the more effective hydrogenation. L. R.

281. Patent on Hydrogenation. G. W. Johnson. E.P. 497,607, 22.12.38. Appl. 21.7.37. Mechanical separation of solid substances from oil residues formed by the destructive hydrogenation or cracking of carbonaceous substances in the presence of diluents boiling between 160° and 250° C., and effecting mechanical separation by filtering or centrifuging. W. S. E. C.

Polymerization.

282. Patents on Polymerization. M. W. Perrin, E. W. Fawcett, J. G. Paton, E. G. William, and I.C.I. Ltd. E.P. 497,643, 22.12.38. Appl. 22.4.37. Interpolymerization of ethylene with organic compounds, *e.g.*, propylene, *iso*butylene, pentene or *iso*-pentene, at 100–400° C. under 1500 atm. pressure in the presence of free oxygen or benzoyl peroxide, to produce high mol. wt. compounds.

W. B. Plummer. U.S.P. Reissue 20,950, 13.12.38. Appl. 7.2.36 (original U.S.P. 1,991,353, 15.2.35). Polymerization of unsaturated gases to increase the olefine content and subjecting to recycling and polymerizing treatment. W. S. E. C.

Refining and Refinery Plant.

283. Control of Wax Distillate Quality. E. A. Burch. *Nat. Petrol. News*, 30.11.38, **30** (48), R. 582.—The analytical methods applied to the quantitative separation of wax from oil–wax mixtures in the control of solvent extraction processes for lubricating oil refining are presented. Wax is defined as that material which, when separated from the oil–wax mixture, leaves an oil of the desired pour point (usually 0° F.). The classical methods for the separation of wax are not satisfactory and the choice of the

solvent must always depend on the nature of the oil–wax mixture. The desiderata of this choice are: (i) High solvent action for both oil and wax at relatively high temperatures. (ii) High solvent action for oil and low solvent action for wax at low temperatures. (iii) Low boiling point to facilitate recovery. (iv) Chemical stability, low toxicity and low price. Methylene chloride, with or without additions of ethylene dichloride, benzol or acetone, has been found to be most suitable. The actual conditions of nature of solvent, solvent-oil–wax mixture ratio and dewaxing temperatures are determined experimentally, the precise routine of the analytical procedure being a matter for the choice of the operator. Minus 14° F. is recommended as a standard dewaxing temperature when 0° F. pour test oil is desired. Sufficient oil and wax are separated for the determination of the viscosity index of the former and the melting point of the latter. The scale-wax content of the separated wax is then determined by filtering a 2·5% wt. solution of the wax in a mixture of 75% acetone and 25% methylene chloride at 0° C. Thus optimum conditions may be determined for maximum yields of oil of a desired pour point and viscosity index together with data concerning the yield and melting point of the wax. H. G.

284. Control of Wax Distillate Quality. J. W. Donnel and E. A. Burch. *Nat. Petrol. News*, 14.12.38, **30** (50), R. 602.—The desiderata of the experimental control of slack-wax sweating is discussed and a pilot plant for this purpose described. Two types of slack-wax are considered, (*a*) hot slack, separated at 35–40° F., and (*b*) cold slack, separated at minus 5–0° F. The points considered are: time cycle of sweating in relation to yield, the recycling of intermediate waxes, origin of crude and nature of wax distillate cut, blending of different slacks, sweater cake thickness, effect of atmospheric conditions, etc. Conditions must be further considered in relation to (i) the concentration of wax in the slack, (ii) the distillation range of the wax or of the original waxy distillate, (iii) the melting-point range of the wax in the slack. In general slacks containing more than 50% oil cannot be sweated. Slacks should be cooled at a minimum rate to induce the coarse crystalline structure which is necessary for efficient sweating. Other factors being equal the yield of scale varies as the sweating time, economic considerations being the limiting factor. H. G.

285. Tetraethyl-lead Susceptibilities of Gasoline. L. M. Henderson, W. B. Ross and C. M. Ridgway. *Industr. Engng Chem.*, 1939, **31** (1), 27–30.—This investigation was undertaken with the object of comparing the tetraethyl-lead susceptibilities of caustic-washed gasolines with those treated with sodium plumbite and sulphur. The experimental evidence indicated that, when gasolines are treated with sodium plumbite and sulphur, they require more tetraethyl-lead to produce a given octane number than do those treated with sodium hydroxide alone, and similarly, more than do those which are thoroughly scrubbed with caustic and then subsequently treated with sodium plumbite and sulphur. The differences in amount of tetraethyl-lead are quantitatively related to the amount of mercaptan sulphur removed by the caustic washing.

The decreased requirements of tetraethyl-lead accomplished by efficient caustic scrubbing would result in large economic savings in the petroleum industry.

H. E. T.

286. Sample Computations of Natural Gasoline Absorber Data. R. H. Turner. *Petrol. Engr*, December, 1938, **10** (3), 54.—The principles involved in the calculation of absorber tower capacity, analyses of products and other factors are discussed mathematically and typical calculations made. Bubble tower capacity depends on several factors including (i) distance between trays and plates, (ii) mol. wt. of the gas or vapours, (iii) the absolute operating pressure, (iv) the quantity of liquid passing downwards and (v) the depth of liquid on the plates. Experience has shown that 18 in. is the most economical distance between plates for gasoline plants. In bubble towers the allowable shell velocity is 2 ft. per sec. at atmospheric pressure and 18 in. tray spacing for a fluid of mol. wt. 125, this velocity varying as the ratio of the square roots of the molecular weight and also as the ratio of the square root of the absolute operating pressure.

Typical calculations are given of the allowable cap velocity and the capacity of an

absorber under specified conditions. A table is given showing the capacity of bubble towers per 1000 cu. ft. of gas per cap per 24 hr. from which the optimum size of tower can be calculated. Other calculations are worked out for the oil rate for any given set of conditions, the fat oil saturation, the quantity of the oil present, fractions condensing and weathering. C. L. G.

287. Heat Characteristics of 5 Silicon-Chromium-Molybdenum Steels. A. E. White, C. L. Clark and W. G. Hildorf. *Oil Gas J.* Part I, 1.12.38, **37** (29), 43. Part 2, 8.12.38, **37** (30), 43.—In the design of high temperature equipment, permissible stresses are at present usually based upon the creep characteristics of the proposed steels at the given operating temperatures. The usual creep tests, however, give little information with respect to influence of lack of surface or structural stability on the load-carrying ability or on the ductility characteristics. Stress-rupture tests are believed to give the additional information and to provide a more simple means for determining design stresses for certain types of high temperature equipment. Increased resistance to oxidation and sulphide corrosion can be obtained through proper combination of silica and chromium.

Five steels, known as Sicromo 1, 2, 2½, 3 and 5, were examined. They contain essentially the same amounts of Mn, S, P and Mo, and with one exception the Si content is 1·32 to 1·57%. The Cr contents, however, range from 1·30 to 4·83% and the C content from 0·09 to 0·15%. Each steel, prior to machining, was annealed at 1550° F. The following properties were determined on these and certain other steels, and results are recorded: Chemical composition, grain size, Brinell hardness, tensile properties and Charpy impact resistances at temperatures ranging from 80° F. to 1500° F., creep characteristics at temperatures of 800° F. to 1300° F. and stress-rupture characteristics at temperatures of 900° F. to 1500° F. Oxidation resistance characteristics, the effect of temperature and time on impact resistance, tensile properties, impact resistances and metallographic structures of completed creep specimens, and metallographic structures of stress-rupture specimens were also determined, and various tables and illustrations summarize the results obtained.

The main conclusions reached are that acceptable steels for high temperature service up to 1300° F. can be obtained through the addition of Si in amounts up to 1·50% to steels containing varying amounts of Cr and 0·50% of Mo. The resulting steels possess a very suitable combination of strength, ductility and impact resistance at room temperature. On the basis of 1000-hour creep tests under slightly oxidizing conditions, the addition of Si in this amount lowers creep strength at certain of the elevated temperatures, but on account of the increased surface and structural strength imparted it does increase load-carrying ability at these temperatures as indicated by the stress-rupture results. Increased Si content thus increases actual service life, though it decreases creep strength. The Sicromo steels possess a large degree of high temperature stability, retaining their original properties under the combined influences of time and stress at each temperature considered. Hot ductility characteristics are also good under the influence of time, temperature and stress, thus assuring that brittle type fractures will not be obtained in service. R. A. E.

288. Uruguayan Government Refinery Uses Crudes from South America. R. Deambrosis. *Oil Gas J.*, 29.12.38, **37** (33), 134.—The ANCAP refinery at La Teja near Montevideo, Uruguay, began operations in January 1937 and now supplies practically all the country's fuel requirements. The refinery consists of a topping plant of capacity 800 cu. metres per day, a cracking unit of capacity 300 cu. metres per day, refinery equipment for caustic soda, doctor and acid treatment and the usual auxiliary plant. Ecuadorian and Peruvian crude is distilled, the total yearly throughput of 265,000 cu. metres yielding 80,000 cu. metres gasoline, 58,000 cu. metres kerosine, 23,500 cu. metres gasoil and 100,000 cu. metres of topped crude. The cracking unit produces from this stock 50,000 cu. metres gasoline, 39,000 cu. metres of fuel oil and 10,000,000 cu. metres of gas (burnt in the refinery). Properties of the two crudes, and of the products from the topping of the mixed crudes and from the cracking of the mixed reduced crudes are given. C. L. G.

289. Methods of Testing the Adequacy of Electrical Grounds. C. A. Anderson. *Petrol. Engr*, December, 1938, **10** (3), 51.—A description is given of an A.C. testing apparatus

for the adequacy of service grounds used for lightning and high potential hazards or for the return path for electrical equipment circuits, etc. The apparatus consists of an induction bridge circuit in which resistance in one arm can be varied to equal the non-inductive resistance of the other arm. The neutral point is obtained audibly using an electrical wave from a magneto test set. Examples are given of applications of this apparatus, showing its value in locating inefficient grounding, this method being preferred to D.C. testing. C. L. G.

290. Patent on Refining. R. S. Danforth. U.S.P. 2,140,450, 13.12.38. Appl. 26.4.34. Improved method of distillation of hydrocarbon oils.

O. Wolf and R. C. Powell. U.S.P. 2,141,633, 27.12.38. Appl. 6.7.35. New type of furnace and heater for heating hydrocarbon oils to temperatures above 800° F. W. S. E. C.

Chemistry and Physics of Petroleum.

291. Limits of Flammability of Mixtures of Propane, Air, and Nitrogen Oxide. E. B. Hodge. *Industr. Engng Chem.*, 1938, **30** (12), 1390.—The upper and lower limits for this mixture were determined for upward propagation over the complete range. The results are given in a table and plotted on triangular co-ordinates. P. D.

292. Performance of Commercial Perforated-Plate Distillation Column. R. C. Gunness and J. G. Baker. *Industr. Engng Chem.*, 1938, **30** (12), 1394.—Perforated plate columns are commonly used in industry when distilling stock which deposits solid material that would clog and render bubble-cap columns inefficient. Two tests were made on a sixteen-plate column used for the distillation of alcohol from mash. The column was 5½ ft. in diameter, with a plate spacing of 18 in. The size of the perforations was ¼ in. and there were about 2500 per plate. The two tests gave reasonably concordant results, and the individual plate efficiencies (based on the Murphree definition of efficiency) ranged from 20% at the bottom to 50% at the top, with an average of 40%. The first test was made 34 days after cleaning and the second after 72 days. There was no indication of a drop in efficiency in the second test, showing that fouling was not sufficient to impair operation. P. D.

293. Heat Transfer to Boiling Liquids. F. H. Rhodes and C. H. Bridges. *Industr. Engng Chem.*, 1938, **30** (12), 1401.—As the heat transfer rate from a tube wall to a boiling liquid is progressively increased a change in the character of boiling is obtained. At low rates (small temperature difference between tube and liquid) vaporization is nuclear, and the heat transfer coefficient is high. At high rates (large temperature difference) the vapour is produced in a film, spread over the wall surface, which gives a considerable thermal resistance and consequently low coefficient. The change takes place at a critical temperature difference between wall and liquid. This temperature difference was determined for water boiling in a steel tube 0·192 in. internal diameter at pressures from atmospheric down to 2 in. of mercury. With a clean tube a critical temperature difference of 50 to 60° C. was obtained at pressures of 5 and 10 in. of mercury, but the evaporation remained nuclear at pressures of 1 atm., 20 in. and 2 in. up to this temperature difference. The presence of oleic acid or mineral oil as a film on the steel considerably reduces the critical temperature difference, while the presence of sodium carbonate or chloride in an oily tube removes the oil layer and favours nuclear boiling.

Experiments were also made in a chromium-plated tube, and the critical temperature difference was found to be lower than with clean steel. P. D.

294. Exhaustive Fractionation of the "Extract" Portion of the Lubricant Fraction from a Mid-Continent Petroleum. B. J. Mair and C. B. Willingham. *Bur. Stand. J. Res., Wash.*, 1938, **21** (5), 535–563.—Lubricating stock from a mid-continent crude, distilled in a commercial vacuum still, was given the following treatment:

(i) separation of an extract portion by extraction with liquid SO_2 at room temperature, (ii) separation of a wax portion by crystallization from ethylene chloride at − 18° C., (iii) separation of remainder by filtration through silica gel into (*a*) a water white filtrate, (*b*) portion recovered from silica gel and called silica gel hold-up.

In this paper the investigation of fractions 1 and 3(*b*) is described. Fraction 1 was extracted with liquid SO_2 and petroleum ether at − 55° C., the petroleum ether soluble portion combined with fraction 3(*b*) and the whole submitted to a systematic fractional distillation in high vacuo until substantially constant boiling fractions were obtained.

Five charges of these fractions of from 500–700 gm. each were separated into 30 or 40 fractions by extraction with methyl cyanide or methyl cyanide and acetone. Kinematic viscosities at 100° F. and 210° F., refractive indices at 25° C., densities, refractive dispersions, specific optical rotations and aniline points were determined for most of the fractions from the extraction process. In addition C, H ratios, molecular weights and boiling points were determined on 41 key fractions and for some of them also % S and % N_2.

A number of interesting facts in connection with the properties of these petroleum fractions emerge from this work. D. L. S.

295. Hydrogenation of the " Extract " Portion of the Lubricant Fraction from a Mid-Continent Petroleum. B. J. Mair, C. B. Willingham and A. J. Streiff. *Bur. Stand. J. Res., Wash.*, 1938, **21** (5), 565–580.—To investigate the composition of the extract portion of the lubricant fraction from a mid-continent petroleum, 15 portions prepared by extensive distillation followed by exhaustive extraction, were completely hydrogenated.

Hydrogenation was carried out in a bomb using a nickel catalyst, and was continued until the specific dispersion decreased to about 100, a value characteristic of naphthenes. Tables are included comparing the physical constants of the fractions before and after hydrogenation. Evidence is given which indicates that under the conditions of these experiments—temp. 230–250° C. and pressures of H_2 170–210 atmospheres, the fractions were completely hydrogenated and that no breakdown of the molecules occurred. D. L. S.

296. The Ethane Equilibrium. R. N. Pease and A. M. Byers, Jr. *J. Amer. chem. Soc.*, 1938, **60**, 2489–2491.—It has been suggested that the experimental data on the position of equilibrium in the reaction $C_2H_4 + H_2 \rightleftharpoons C_2H_6$ are in error because of the occurrence of side-reactions in general, and particularly, because the alleged presence of propylene has interfered with the analytical determination of ethylene. Additional experiments confirm the earlier conclusions of Travers and Hockin.

A comparison of all experimental values with values based on the Nernst Heat Theorem (and the Third Law) emphasizes the internal consistency of the data.

It is concluded that there is no good ground for ignoring the experimental data on the ethane equilibrium in dealing with the question of free rotation in the ethane molecule. T. C. G. T.

297. Fluorinated Derivatives of Propane. II. A. L. Henne and E. C. Ladd. *J. Amer. chem. Soc.*, 1938, **60**, 2491–2495.—Three chlorinated propanes C_3Cl_8, $CHCl_2CCl_2CCl_3$, $CCl_3CHClCCl_3$ have been synthesized, and then fluorinated to give eight fluorine derivatives. The structures and properties of those derivatives, together with three others, are presented. T. C. G. T.

298. Reaction of *iso*Butene and di-*iso*Butene with Phenol, with and without Scission of C–C Linkages. V. N. Ipatieff, H. Pines and B. S. Friedman. *J. Amer. chem. Soc.*, 1938, **60**, 2495–2497.—Phenol is alkylated with di-*iso*butene, at temperatures up to 150°, in the presence of phosphoric acid or with a large excess of sulphuric acid, to yield 4-*t*-butylphenol and 2 : 4-di-*t*-butylphenol.

Phenol is alkylated by *iso*butene in the presence of phosphoric acid at 100° to give good yields of *p*-*t*-butylphenol and 2 : 4-di-*t*-butylphenol.

When *p*-($\alpha\alpha$,$\gamma\gamma$-tetramethobutyl)phenol was heated under pressure with phosphoric acid, the side-chain was cleaved to produce phenol, octenes, *p*-*t*-butylphenol, and 2 : 4-di-*t*-butylphenol. T. C. G. T.

299. Addition of Sulphur, Hydrogen Sulphide and Mercaptans to Unsaturated Hydrocarbons. S. O. Jones and E. Emmett Reid. *J. Amer. chem. Soc.*, 1938, **60**, 2452–2455.—Sulphur strips H_2 from unsaturateds to form H_2S a part of which adds to the double bond to produce a mercaptan, which adds to more of the unsaturate to give a sulphide. The addition of H_2S takes place readily and is catalyzed by S. The addition of mercaptans, as also that of H_2S, to double bonds, follows Markownikoff's rule in the absence of peroxides. As there are usually sufficient peroxides, for catalytic purposes, in the hydrocarbon, the abnormal addition is difficult to suppress.

T. C. G. T.

300. Physical Constants of *cis*-Pentene-2. M. L. Sherrill and E. H. Launspach. *J. Amer. chem. Soc.*, 1938, **60**, 2562–2563.—The *cis*-pentene-2 was prepared by the semi-reduction of pentene-2 and was found to possess the following constants, b.-pt., 37·0° ± 0·05°, $n^{20}D$ 1·3822, d_4^{20} 0·6562.

T. C. G. T.

301. Properties of Purified Normal Heptane and *iso*Octane (2 : 2 : 4-Trimethyl Pentane). D. B. Brooks. *Bur. Stand. J. Res., Wash.*, 1938, **21** (6), 847–852.—Work is in hand to develop specifications for *n*-heptane and *iso*octane which are used as primary standard reference fuels for the knock rating of automotive engine fuels. In this connection it was necessary to obtain data on the physical properties of samples of the highest possible purity.

To this end the purest available materials were further purified and the boiling-points, freezing-points, refractive indices, densities and certain of their differential coefficients accurately measured on the resulting materials. In each case the freezing point of the best material obtained was higher than currently accepted values.

D. L. S.

302. Physical and Chemical Constants of Normal Paraffins. D. J. W. Kreulen. *J. Instn Petrol. Tech.*, 1938, **24**, 554–561.—The density, refractive index, aniline point, viscosity and surface tension of a series of fractions consisting entirely of normal paraffins have been determined and their relationships demonstrated by a number of graphs.

D. L. S.

303. Principles of Solvent Dewaxing. Part IV. The Precipitation of Wax from Solution in Oil by Oil-miscible Liquids. M. Ba Thi, T. G. Hunter and A. W. Nash. *J. Instn Petrol. Tech.*, 1938, **24**, 562–576.—The factors involved in precipitating wax from solution in oil are discussed. It is pointed out that the suitability of a liquid for dewaxing operations is dependent primarily on the solubility of wax in the oil, in conjunction with the solubility of wax in such a dewaxing liquid.

D. L. S.

304. The Nonanes. F. C. Whitmore and H. A. Southgate. *J. Amer. chem. Soc.*, 1938, **60**, 2571–2572.—The paper describes the synthesis of three new Nonanes, namely, 3-ethylheptane, 2 : 3-dimethylheptane and 2 : 2 : 4 : 4-tetramethylpentane. As the data on 2-methyloctane were meagre, this compound was also prepared.

The 2 : 2 : 4 : 4-tetramethylpentane was obtained from 2 : 2 : 4-trimethyl-4-bromopentane, using dimethyl zinc. The three other nonanes were obtained by dehydration of the tertiary alcohols. The physical properties of the hydrocarbons obtained are shown below :

Nonane.	F.-p., °C.	B.-p. (760 m.) °C.	$n^{20°}D$.	$D_4^{20·1}$.	Viscosity. 37·8 °C. Poises × 10.	Viscosity. 100 °C. Poises × 10.
2-Methyloctane	− 80·1	142·80	1·40285	0·7107	5·25	2·79
2 : 3-Dimethylheptane	(−116·7) glass	140·65 initial	1·40850	0·7235	5·21	3·30
3-Ethylheptane	(−114·9) glass	143·10	1·40900	0·7260	4·90	2·61
2 : 2 : 4 : 4-Tetramethylpentane	− 66·9 to −67·1	122·30	1·40695	0·7185	6·80	3·39

W. E. J. B.

305. New Synthesis of Tertiary Hydrocarbons. F. C. Whitmore and H. P. Orem. *J. Amer. chem. Soc.*, 1938, **60**, 2573–2574.—Five tertiary aliphatic hydrocarbons have been prepared from the corresponding tertiary alcohols by a modified Levene method. The alcohols are treated with dry hydrogen iodide until 1½ times the theoretical quantity has been added. Zinc dust is then added in small quantities until reaction ceases. Dry hydrogen chloride is then passed in with the addition of more zinc until 4 times the theoretical quantity is added. The reaction temperature is raised to 70–80° C. with stirring, and the addition of hydrogen chloride continued.

The hydrocarbon is obtained by water dilution followed by steam distillation. After purification, the physical constants determined are shown below :

Hydrocarbons.	B.-p., °C.	Mn.	n_4^{20}.	n_D^{20}.	F.-p., °C.	Yield. %
2-Methylhexane	90·3	760	0·6794	1·3851	−120·3	23·7
2-Methyloctane	142·8	760	0·7132	1·4030	−120·3	48·8
3-Ethylheptane	143·1	760	0·7272	1·4090	−120·3	38·3
3-Methylnonane	167·6	760	0·7319	1·4123	−90·0	30·1
4-Methyldecane	188·1	760	0·7422	1·4177	−92·9	27·8

W. E. J. B.

306. Hexamethylethane and Tetra-alkylmethanes. R. E. Marker and T. S. Oakwood. *J. Amer. chem. Soc.*, 1938, **60**, 2598.—A practical method is given for the preparation of hexamethylethane and other hydrocarbons containing a tertiary group by condensation of an alkyl Grignard reagent with a tertiary halide by means of cuprous iodide.

The hydrocarbons noted below, were obtained :

	B.-p., (760 mm.) °C.	n_D^{20}.	d_4^{20}.
2 : 2-Dimethylbutane	49·6	1·3709	0·6491
2 : 2-Dimethylpentane	79·0	1·3825	0·6739
2 : 2-Dimethylhexane	105·2	1·3942	0·6934
2 : 2-Dimethylheptane	130·4	1·4035	0·7105
3 : 3-Dimethylpentane	86·0	1·3911	0·6937
3 : 3-Dimethylhexane	112·0	1·4008	0·7107
3 : 3-Dimethylheptane	137·2	1·4087	0·7254
3 : 3-Dimethyloctane	161·2	1·4165	0·7390

W. E. J. B.

307. Vinyl Halide Polysulphones. Peracetic Acid as a Catalyst for the Reaction between Sulphur Dioxide and Olefins. C. S. Marvel and F. J. Glavis. *J. Amer. chem. Soc.*, 1938, **60**, 2622–2626.—The catalytic activity which certain samples of aged paraldehyde have shown in promoting the reaction between olefins and sulphur dioxide can be obtained by use of peracetic acid solutions.

Vinyl chloride and vinyl bromide combine with sulphur dioxide in the presence of active paraldehyde or peracetic acid to give a polymer of the composition $((CH_2{=}CHX)_2SO_2)_n$, rather than the usual one to one type of polymer. A preliminary study of the reaction of the vinyl halide polymer has not indicated its structural unit.

No evidence for compound formation was obtained from the examination of freezing-point composition curves for solutions of styrene, 1-pentene and 10-hendecenoic acid in liquid sulphur dioxide. W. E. J. B.

308. Instability of Liquid *iso*Butene. E. E. Roper. *J. Amer. chem. Soc.*, 1938, **60**, 2699–2701.—It has been shown that *iso*butene (2-methylpropene) in the liquid phase forms a high-boiling liquid upon standing, which probably is a polymer, with certain evidence pointing to dimerization as the first step.

At 0° C. this reaction causes a lowering of the pressure of the saturated vapour of pure *iso*butene to the extent of about 0·6%. The other three butenes do not exhibit such behaviour. W. E. J. B.

309. Reaction of Aliphatic Olefins with Thiophenol. V. N. Ipatieff, H. Pines and B. S. Friedman. *J. Amer. chem. Soc.*, 1938, **60**, 2731–2734.—The addition of thiophenol to aliphatic olefins proceeds contrary to Markownikoff's rule. Propene, butene-1, *iso*butene, pentene-1, *iso*propyl, ethylene, and trimethylethylene react with thiophenol in the absence of acid catalysts to yield *n*-propyl, *n*-butyl, *i*-butyl, *n*-amyl, *i*-amyl and *s*-isoamyl phenyl sulphides, respectively. The presence of 90% phosphoric acid scarcely affected the course of the reaction, since the olefins react more readily with thiophenol than with the acid.

In the presence of sulphuric acid (diluted with water or acetic acid) the reaction proceeds in accordance with Markownikoff's rule: *iso*butene and trimethylethylene yield *t*-butyl and *t*-amyl phenyl sulphides, respectively.

Isomerization occurs during the reaction of *iso*propylethylene with thiophenol in the presence of sulphuric acid. The product is *t*-amyl phenyl sulphide and not the expected *s*-isoamyl phenyl sulphide.

The physical properties of a number of alkyl phenyl sulphides are described. Several of these were characterized by preparation of solid derivatives. W. E. J. B.

310. Heats of Organic Reactions. VII. Addition of Halogens to Olefins. J. B. Conn, G. B. Kistiakowsky and E. A. Smith. *J. Amer. chem. Soc.*, 1938, **60**, 2764–2771.—The authors have determined the heats of reaction involved in certain brominations and chlorinations of various unsaturated hydrocarbons. The paper should be consulted for the actual data obtained, but one conclusion to be drawn from the work is that substitution on the ethylenic group results in an increased heat evolution on addition of bromine, whereas previous work had indicated that as far as hydrogenation was concerned, the heat of reaction was diminished by such substitution.

The observed trends afford a thermo-dynamic basis for the so-called Markownikoff rule, and for the tendency of bromine to replace hydrogen on the most substituted carbon atom of a saturated hydrocarbon.

A method of calculation is given which enables the prediction of the heats of addition of hydrogen halides and of bromine substitution, to be made. W. E. J. B.

311. Interaction between Methylene Radicals and Hydrogen. C. Rosenblum. *J. Amer. chem. Soc.*, 1938, **60**, 2819–2820.—The photolysis of ketene in the presence of hydrogen indicates a reaction between methylene radicals and hydrogen. At 200° C.—*e.g.*, reaction products consisted of methane, a gaseous fraction with a mean composition $C_{2\cdot48}H_{7\cdot36}$ and a residue with an average composition C_4H_{10}.

A suggested reaction is $CH_2 + H_2 = CH_3 + H$.

A secondary source of methyl radicals might be a reaction between methylene radicals and methane already formed.

The source of methane is probably an interaction of methyl radicals with hydrogen or hydrocarbons, whilst the recombination of methyl radicals to form ethane would account for the mean composition of the gaseous phase. W. E. J. B.

312. Hydrogen Fluoride as a Condensing Agent. II. The Alkylation of Benzene by Olefins. J. H. Simons and S. Archer. *J. Amer. chem. Soc.*, 1938, **60**, 2952–2953.—Hydrogen fluoride has been found to be a very useful agent for the alkylation of benzene by olefins. Propylene, *iso*butene, pentene-2, trimethylethylene, and *cyclo*hexene were used. Very good yields were obtained.

Under the conditions employed, no evidence was found for any reaction except alkylation. The alkyl benzenes formed were identified by means of physical constants and by conversion to the monoacetamino derivatives. W. E. J. B.

313. Hydrogen Fluoride as a Condensing Agent. III. Alkylation of Aromatics with Aliphatic Halides. J. H. Simons and S. Archer. *J. Amer. chem. Soc.*, 1938, **60**, 2953–2954.—Hydrogen fluoride has been found to be an effective agent to promote

the reaction between alkyl halides and aromatic compounds. The halides used were *n*-propyl bromide, *iso*propyl chloride, *t*-butyl chloride and *t*-amyl chloride, and the aromatic compounds were benzene, toluene and naphthalene. W. E. J. B.

314. Hydrogen Fluoride as a Condensing Agent. IV. Reaction of *cyclo*Propane with Benzene. J. H. Simons, S. Archer and E. Adams. *J. Amer. chem. Soc.*, 1938, **60**, 2955–2956.—*cyclo*Propane has been found to react with benzene catalyzed by hydrogen fluoride to give normal propylbenzenes in good yield. A possible mechanism for the reaction is postulated which involves an ionic mechanism. The *cyclo*propane molecule is assumed to add a proton to form a hypothetical and transitory propyl ion.
W. E. J. B.

315. System Correlating Molecular Structure of Organic Compounds with their Boiling-Points. I. Aliphatic Boiling-Point Numbers. C. R. Kinney. *J. Amer. chem. Soc.*, 1938, **60**, 3032–3039.—The author has developed a system for correlating the structure of organic compounds with their boiling-points. The concept of boiling-point number (B.P.N.) has been introduced and values of 0·8 and 1·0 units have respectively been ascribed to carbon and hydrogen as the atomic B.P.N's.

In considering any molecule the B.P.N. is considered to be composed of two parts, that due to the hydrogen atom or the hydrocarbon residue, and that due to the characteristic atom or group. In general, the calculated values are in good agreement with those observed, and it is anticipated that the new method will become a useful help in either calculating the boiling-point of a compound from its structure, or its structure from the boiling-point. W. E. J. B.

316. Viscosities of Hydrocarbons. Parts VII and VIII. E. B. Evans. *J. Instn Petrol. Tech.*, 1938, **24**, 537–553.—This paper contains data on the viscosities of nineteen monocyclic aromatic hydrocarbons with from six to sixty carbon atoms and of sixty-two polycyclic hydrocarbons comprising compounds with two or more ring structures. The latter contain from nine to thirty-eight carbon atoms and many of them may be of interest in connection with the composition and properties of lubricating oil fractions.
D. L. S.

317. Action of Mineral Acids on Primary Nitroparaffins. S. B. Lippincott and H. B. Hass. *Industr. Engng Chem.*, 1939, **31** (1), 118–120.—Acetic, propionic, butyric and *iso*butyric acids have been prepared by refluxing the corresponding primary nitroparaffins with 85% sulphuric acid. Hydroxylamine acid sulphate is a by-product in the reaction. Propionohydroxamic acid was prepared from 1-nitropropane and concentrated sulphuric acid. H. E. T.

318. Surface Tension of Hydrocarbons. D. L. Katz and W. Saltman. *Industr. Engng Chem.*, 1939, **31** (1), 91.—The surface tensions of ethane, propane and *n*-butane were determined under equilibrium vapour pressures over the temperature range 0° to 45° C. This data and that for other paraffin hydrocarbons and hydrocarbon mixtures given in the literature are correlated by plotting surface tension against reduced pressure. From this graph a chart connecting surface tension, temperature and molecular weight is drawn. The surface tensions of non-paraffin hydrocarbons are plotted against temperature on a third graph. The reduced temperature plot can be used to estimate critical temperatures of mixtures whose surface tension is known. P. D.

319. Catalytic Agent as Important Factor in the Pyrolysis Process. R. Fussteig. *Petrol. Engr*, December, 1938, **10** (3), 33.—The behaviour of catalysts is explained on the basis of modern theories of the structure of atoms, and the results of experimental work on the preparation and selection of catalysts for use in pyrolysis reactions discussed. The surface of the catalyst is considered to consist of unsaturated matter which adsorbs a molecule of, *e.g.*, hydrogen splitting atoms into electrons and nuclei, the former penetrating the light movable electrons of the catalyst and the latter adhering to the surface of the catalyst where they are able to react with split hydrocarbon

nuclei. The adsorbed molecules are submitted to a deformation which forms a new field of force opposite the neighbouring gas space, *i.e.*, becoming more active. The quantity and quality of these light movable electrons in the catalyst control its activity and depend on the nature and method of activation of the catalyst. Catalysts formed by precipitation on earth are very voluminous, and require a high gas velocity which reduces yields, and have poor heat conductivities. The skeleton type in which Ni is melted with Al or Si and the latter removed with Na_2CO_3 or NaOH is better in this respect.

The particle size of the catalyst is of extreme importance as a medium-sized grain contains a greater number of electrons on its surface than the fine-sized grain. The traces of $Ni(NO_3)_2$ in precipitated catalysts reduces their life owing to their disturbance of the electric field at many points on the surface. The electrons and nuclei of nickel skeleton catalysts are considered more active in inducing the formation of olefine hydrocarbons than those of precipitated nickel.

In a study of catalysts prepared from different proportions of Al and Ni it was found that a 60–40 Al Ni alloy gave the best results and that the addition of Fe and Co improved the activity, while Mn and Cu reduced it, in spite of the fact that the iron skeleton is quite inactive, and the Mn skeleton very active. It is considered that the contact of certain metal skeletons causes an increase of the splitting into electrons and nuclei, and that, as the electrical power of atoms of precipitated metal differ from those of the same metal as a skeleton, optimum results are obtained by combining the two types in the proper ratio.

Gasoline-forming catalysts may be of three types (i) those unable to keep labile the active $=CH_2$ radicals long enough, resulting in hydrogenation to paraffinic hydrocarbons or polymerization, (ii) those able to keep the $=CH_2$ radicals labile long enough to allow olefine hydrocarbons to be formed, (iii) those having in addition sufficiently active nuclei and electrons to transform the olefines into cyclic hydrocarbons.

Other catalysts tested include Co–Al skeleton (low activity—very short life), and a Co skeleton impregnated with precipitated Co (higher activity than either element). The addition of 10% of precipitated Thorium or Mn plus precipitated Co to the Co skeleton increased the yield very considerably. A Ni–Si skeleton also gave very low yields though a little improved by the addition of precipitated Ni and Thorium. On the other hand, the Co–Si alloy gave better results than the Al–Co alloy. The highest yields were obtained with a cobalt skeleton from a Co–Si alloy mixed with precipitated Co and impregnated with a Mo salt and reduced.

It is emphasized that the proper use of catalysts involves the selection of mixtures of catalysts of the correct type for the required reactions. C. L. G.

Analysis and Testing.

320. Determination of the Aniline Point of Dark Petroleum Products. W. R. Van Wijk and J. W. M. Boelhouwer. *J. Instn Petrol. Tech.*, 1938, **24**, 598–604.—The aniline point of dark oils is determined by measuring their transparency to infra-red rays. An apparatus for testing six samples simultaneously is described.

D. L. S.

Motor Fuels.

321. Patents on Motor Spirit. H. Dreyfus. E. P. 496,292, 29.11.38. Appl. 29.5.37. Synthesis of hydrocarbons from CO and H_2 at 150–350° C. and under an absolute pressure of 0·1–0·25 atm. at the most, in the presence of a hydrogenating catalyst, *e.g.*, a metal of Group 8 and a metal oxide. Steam, CO_2, or hydrocarbon gases or vapours are added as diluent.

A. E. J. L. Germe. E.P. 496,607, 2.12.38. Appl. 9.6.37. Treatment of natural and commercial mixtures of hydrocarbons containing aromatics to enrich the aromatic content, by allowing nascent O_2 (from the action of solid potassium bichromate and

concentrated H_2SO_4), to act on the polyethylene derivatives. The treated mixture is washed first with water and then with 1% solution of anhydrous Na_2CO_3 at 50–60° C.

N. V. de Bataafsche Petroleum Mij. E.P. 496,676, 5.12.38. Appl. 7.6.37. Manufacture of *iso*butene derivatives by isomerization at 325° C. of butene-1 or butene-2 or mixtures of these compounds. The reaction is carried out in the presence of water vapour and a catalyst obtained by mixing phosphoric acid and kieselguhr and heating the mixture to 300° C. The mixture obtained may, if desired, be polymerized at 150–250° C. at raised pressure using phosphoric acid as catalyst and the polymer gasoline hydrogenated, if desired.

Ruhrchemie A.-G. E.P. 496,718, 1.12.38. Appl. 1.6.37. Synthesis of benzene from CO and H_2 in the presence of a solid catalyst in a suitable heat-exchanging apparatus comprising a gas-tight reaction chamber traversed by a system of tubes disposed in an inclined position.

G. W. Johnson. E.P. 496,880, 5.12.38. Appl. 3.6.37. Conversion of CO and H_2 into hydrocarbons containing more than 1 C atom and non-gaseous oxygen-containing derivatives of hydrocarbons using as catalyst reducible iron compounds.

Standard Oil Development Co. E.P. 497,255, 15.12.38. Appl. 24.12.37. Sweetening petroleum distillates containing mercaptans by converting the mercaptans into copper mercaptides which remain dissolved in the distillate, and then extracting the Cu salt with ethanolamine. W. S. E. C.

C. O. Hoover. Reissue 20,938, 6.12.38. Appl. 25.5.38 (original U.S.P. 2,042,050, 26.5.38). Sweetening mercaptan-containing distillates by adding an oxygen-containing gas and a controlled amount of moisture and contacting the resultant mixture with an adsorbent material and a copper compound which forms a mercaptide—*e.g.*, cupric chloride.

See also Abstract No. 285.

Gas, Diesel and Fuel Oils.

322. Ageing of I.C. Engine Oils. C. A. Bouman. *Ann. Off. Combust. liq.*, 1938, **13** (2), 353–364.—As a result of previous observations, supplemented by present experimental results, it is considered that "soot" is the chief source of contamination of the sump oil, the amount being greater in the case of diesel engines than in petrol engines. The same oil was tested in each of 6 engines, 3 diesel (single-cylinder) and 3 petrol. Technique was as follows: Speed 1000 r.p.m., four hours at half-load, then a stop followed by four hours at full-load. "Soot" (which included fine carbon) was always greater than "lacquer" (insoluble in 60–80 spirit, soluble in alcohol) or asphaltenes (insoluble in 60–80 spirit and alcohol, soluble in benzene) or ash. Similar results were obtained in a 6-cylinder diesel engine in service. The various contaminants did not increase indefinitely with time, but tended to reach limiting values when correction is made for new oil added. It is concluded that since the major part of contamination is external and independent of oil quality, no artificial ageing test can give a practical answer. J. L. T.

323. Gas Oils and Fuel Oils. E. Prévost. *Rev. Comb. Liq.*, October, 1938, **16** (158), 271–282.—The author traces the history of gas oils and fuel oils, and it is interesting to note that the specification of the U.G.I. (United Gas Improvement Co.) was the only one in existence in 1920 and its entire purpose was to specify oils suitable for enriching coal gas. The first official specifications were formulated on the 3rd February, 1922, under the heading of "United States Government Standard specification No. 2c," but these did not include gas oils. French government specifications as defined by a government decree in 1919 call for a minimum viscosity, a maximum (5%) of material removable by sulphuric acid, and the main stipulation that it must yield a distillate of less than 10% at 275° C. by the Luynes Bordas

method, the thermometer being in the liquid. It is stated that for any given hydrocarbon that fraction which distils below 275° C. by the above method will distil below 255° C. by the standard A.S.T.M. method.

The decrees were modified in June 1921 and April 1923 to permit the import of gas oils distilling 20% and 30% respectively below 275° C. by the Luynes Bordas method, this method being officially replaced by the A.S.T.M. distillation in 1934.

In 1937 a decree was issued defining as gas oils all products distilling below 30% at 255° C. by the A.S.T.M. method and as fuel oils all products distilling below 30% at 270° C. by the same method and satisfying the colorimetric test. The latter test was introduced in 1936 to replace the sulphuric tar test and is stated to give an indication of the asphaltene content.

The article gives a very detailed study of the position both in U.S.A. and France between 1919 and the end of 1937. M. M. L.

324. The Ignition Quality of Diesel Fuels. J. Riffkin. *Engineering*, 1939, CXLVII (3808), 1.—The measurement of the delay angle in an engine is discussed in relation to engine knock, and it is suggested that a better correlation would be obtained if commencement of combustion were taken as commencement of rapid combustion as measured by the commencement of a rapid change in pressure. Similarly, it is argued that commencement of fuel injection should be considered as commencement of rapid fuel injection.

The effect of the injection timing on the delay angle is discussed with reference to the procedure to be adopted in determining cetane numbers, and some data obtained from experiments made on a Tangye open-combustion-chamber engine are used in illustration.

Graphical relations are given between the delay angle of blends of reference fuels as measured in the Tangye engine, and the corresponding values of the Aniline Point, Diesel Index, Viscosity–Gravity Index, and Spontaneous Ignition Temperature.

J. G. W.

Lubricants and Lubrication.

325. Aircraft-Engine Lubrication. E. L. Bass and C. H. Barton. *J. Soc. aut. Engrs*, 1939, **44** (1), 8–14.—Valuable data can be obtained, it is considered, from preliminary tests in the laboratory, using single-cylinder engines, on such factors as ring-sticking under detonating (take-off), and weak-mixture (cruising) conditions, carbon formation, bearing corrosion and sludging. Since correlation is not perfect, full-scale engine tests on the bench and in flight are finally necessary. Engines used were J.A.P. and Norton (motor-cycle) and Bristol (aero.). Operating details using the J.A.P. engine were: for ring-sticking tests, 5 hours under (*a*) maximum power with detonation, (*b*) 10% weak mixture with no detonation. Under (*a*) cylinder temperature had to be lowered 10° C. to obtain the same degree of ring gumming as with no detonation.

The test on the Bristol engine was longer and varied from 65½–75 hr. for different oils. The Norton engine is being used for tests of long duration and also to determine the effect on ring-sticking of carbon formation in the grooves ("ring-packing") behind the ring. So far there appears to be little connection. For bearing corrosion tests, the big end was run-in for 4 hr. at normal operating temperature (50–60° C.) followed by 20 hr. at temperatures up to 170° C. An oil is considered satisfactory for most purposes provided corrosion of lead-bronze bearings does not develop below 145° C. Some difficulty has been experienced in correlating small-engine tests with full-scale engine tests in the case of cadmium-base bearings. With such bearings there appears to be increased danger from corrosion by oil. There are notes on the other factors mentioned. As regards carbon formation and the effect on it of temperature and oil consumption the interesting result is given that in the case of the J.A.P. engine, although carbon on the piston crown did not increase with cylinder head temperature, the increase in the carbon in the top ring-groove was very marked as temperature increased. J. L. T.

326. Some Developments Relative to Crankcase-Oil Filtration. A. T. McDonald. *J. Soc. aut. Engrs*, 1939, **44** (1), 23–28.—An attempt is made in this article to clarify

some misconceptions arising out of the claims made for the superiority of the adsorbent (Fullers Earth, Charcoal) type over the absorbent (Cotton Waste) type of filter.

In addition to the removal of natural oiliness agents and additives designed to give greater film strength and freedom from ring-sticking in diesel engines, the former type tend to disintegrate and add abrasive material to the oil. Further, it is considered that fresh oil tends to wash out impurities from such filters which, anyway, cannot possibly cope with all the acidity in an oil and moreover have limited life.

As far as the absorbent type is concerned, these suffer from the defect that they only treat 10% as the oil at any time, the remaining 90% being by-passed. They should be supplemented by screen filters of the full-flow type.

Graphs are given showing the progressive decrease in the efficiency of the adsorbent type filter in removing additive, specifically metal soap, plotting results both from a laboratory test using pump circulation of oil, and also actual operation.

The contentions regarding the dangers from the use of the adsorbent type filter are supported by figures on used oils and photographs of pistons from engines both with and without the absorbent type of filter.

Some useful figures on the accelerating effect of increased temperature on cracking of babbit metal bearings and on corrosion of cadmium-base bearings are also quoted. In this connection the photographs of babbit bearing shells from the same engine operating under the same conditions showing the improved condition resulting from frequent changing without filter as compared with long-time operation with absorbent-type filter are interesting.

In the single contribution to the discussion of this paper there is a timely warning on the dangers of drawing conclusions from results on one particular diesel engine.

J. L. T.

327. Improvements in Diesel-Engine Lubricating Oils. U. B. Bray, C. C. Moore, Jr., and D. R. Merrill. *J. Soc. aut. Engrs*, 1939, **44** (1), 35–42.—Requirements of a diesel-engine lubricant are six-fold :

(i) Detergency to keep rings free and solids in suspension.
(ii) High oiliness to take care of normal operating conditions.
(iii) High film strength to prevent scuffing and scoring under abnormal conditions of stress.
(iv) Non-sludging properties, *i.e.*, high oxidation stability.
(v) Non-corrosiveness to new-type alloy bearings.
(vi) Low carbon-forming tendencies.

As regards (i), metal soaps are considered effective additives to make good the deficiency of straight mineral oils. As regards (ii) the carbonyl group in a soap is thought to be an active factor, whilst for (iii) the chlorine in calcium dichloro-stearate is considered responsible for such improvement shown by oils containing it. It is best added to naphthenic type oils although paraffinic type oils are also improved. As regards (v) no metal soap additive is non-corrosive to lead-base and cadmium-base bearing alloys but the authors think it is only a matter of time before this problem is resolved.

Photographs of pistons and figures for wear and analyses of used oils are put forward to substantiate the claims made for calcium dichlorostearate as an improver of diesel-engine oils.

J. L. T.

328. Rapid Analysis of some Mineral Lubricating Oils. E. André and J. Roche. *Ann. Off. Combust. liq.*, 1938, **13** (2), 339–351.—The compounds in a mineral oil (Roumanian "RRO") considered responsible for rotating the plane of polarized light to the right are thought to be concentrated in that fraction of the oil which is most soluble in acetone and methyl and ethyl alcohols. These compounds are of relatively low molecular weight and contain carbon, hydrogen, oxygen and sulphur. They are associated with hydrocarbons (C_{20}–C_{22}) poor in hydrogen and of greater density than water. It is not known whether they are present as a quaternary compound or as a mixture of ternary compounds.

J. L. T.

329. Safe Viscosity for a Motor-Car Engine Lubricant. S. W. Sparrow. *J. Soc. aut. Engrs*, 1938, **43** (4), 393–402.—On the credit side, low-viscosity oils give high

cranking speeds, rapid flow at low temperatures, increase in brake torque and better fuel economy. On the debit side are tendency to increased oil consumption and blowby, decreased protection to main and big-end bearings, pistons and cylinder walls. As regards bearing protection the theory is advanced that thin oils fail because the oil pump is unable to build up sufficient pressure to overcome centrifugal force thereby militating against adequate flow, the criterion of safe viscosity for con-rod bearings. Larger pumps and improved oil systems may eventually overcome this. Safe viscosity depends on operating temperature. Figures quoted for crankcase oil temperature range from 89–178° F. above atmospheric temperature for a dozen 1938 cars at 70 m.p.h., and 105–195° F. above atmospheric temperature at top speed. Surface finish plays an important part. Different cylinders in the same engine differed widely in their viscosity requirements.

The author believes that the viscosity of the oil used in a new engine should be at least as high as that which is specified for a well run-in engine, and that the greater protection against scoring which is provided by a more viscous oil more than compensates for the extra time required to wear away the high spots of the cylinder wall surfaces. In winter, on cars fitted with thermostatic control of water-jacket temperature giving figures as high as in summer operation, low-viscosity lubricants may be unsafe for pistons and cylinders. This danger is somewhat offset, it is admitted, by the lower driving speeds in winter. Nevertheless, for safe operation of pistons and cylinders oil viscosity should be as high in winter as in summer. The author puts his results more in the form of asking questions than in providing the answers. The graphs and photographs are excellent. The range investigated was from S.A.E. 10W to S.A.E. 50, but viscosity indices of the oils considered are not quoted.

J. L. T.

330. Specific Refractivity and Carcinogenicity of Mineral Lubricating Oils. S. J. M. Auld. *J. Instn Petrol. Tech.*, 1938, **24**, 577–583.—The author has carried out some work on the specific gravity and specific refractivity of oils and of blends of different types of oil from which he concludes that there are serious inconsistencies in the Manchester Committee's specification for non-carcinogenic oils. D. L. S.

331. Manufacture of Cutting Oils. J. F. Miller. *J. Instn Petrol. Tech.*, 1938, **24**, 645–649.—Various types of cutting oils are discussed and the properties demanded of these products are described. D. L. S.

332. Cutting Fluids and the Machine Tool. A. H. Lloyd and H. H. Beeny. *J. Instn Petrol. Tech.*, 1938, **24**, 650–654.—The emulsion type of cutting fluid is discussed in conjunction with its possible corrosive effect on the cutting tool. D. L. S.

333. Selection of Cutting Fluids. H. J. Mason. *J. Instn Petrol. Tech.*, 1938, **24**, 655–661.—The author outlines some practical tests which have been carried out over a period of several years to determine the efficiency of cutting fluids. D. L. S.

334. Functions of Cutting Fluids. H. W. Swift. *J. Instn Petrol. Tech.*, 1938, **24**, 662–671.—The mechanism of metal cutting is discussed and the rôle played by the cutting fluid indicated. D. L. S.

335. Patents on Lubricating Oil. H. W. Brownsdon and I.C.I. Ltd. E.P. 496,717, 30.10.38. Appl. 31.5.37. Preparation of E.P. lubricants by adding to a mineral lubricating oil an addition product—*e.g.*, 0·1% of pyrogallol and 0·1% water, or 0·01% of ethyl formate and 0·01% of water, or 0·0005% of silver chloride solution dissolved in aqueous ammonia, etc.

N. V. de Bataafsche Petroleum Mij. E.P. 496,779, 6.12.38. Appl. 23.12.37. Process of removing naphthenic acids from mineral lubricating oils or lubricating oil fractions by contacting the oils in the vapour phase at temperatures above 300° C. in the presence of a catalyst of high porosity and with a large catalytic surface selected from the group; lithium hydroxide, carbonate or phosphate, sodium hydroxide

or carbonate, potassium carbonate, beryllium oxide or carbonate, magnesium hydroxide or carbonate, or oxides, hydroxides or carbonates of calcium, aluminium, or manganese, etc.

Edeleanu Gesellschaft m.b.H. E.P. 496,955, 8.12.38. Appl. 8.6.37. Dewaxing of hydrocarbon oils using anhydrous pyridine and/or its homologues using nitrobenzene, aniline or chloraniline.

Edeleanu Gesellschaft m.b.H. E.P. 496,956, 8.12.38. Appl. 8.6.37. Solvent refining of hydrocarbon oils using as solvent pyridine or its homologues together with nitrobenzene, aniline or chloronitrile.

Edeleanu Gesellschaft m.b.H. and F. B. Dehn. E.P. 496,991, 8.12.38. Appl. 8.6.37. Process as described in E.P. 496,956, using one of the following: sod. carbonate or hydrosulphide, or pot. nitrite.

I. G. Farbenindustrie A.-G. E.P. 497,541, 21.12.38. Appl. 25.4.38. Production of lubricating oil by polymerizing propylene and α-butylene or mixtures of these.

H. E. R. Vogel. E.P. 497,306, 16.12.38. Appl. 4.12.37. Process and apparatus for testing the lubricating value of lubricating oils.

A. B. Brown and F. F. Diwoky. U.S.P. 2,138,832, 6.12.38. Appl. 15.10.32. Solvent extraction of lubricating oil using mixed solvents—*e.g.*, an aliphatic ether containing more than 8 C atoms and β-chlorinated aliphatic ether containing not more than 8 C atoms.

A. B. Brown and F. F. Diwoky. U.S.P. 2,138,833, 6.12.38. Appl. 2.4.34. Solvent extraction of lubricating oils using a mixture of di(2-chlorethyl) ether and phenol.

A. B. Brown and F. F. Diwoky. U.S.P. 2,138,834, 6.12.38. Appl. 18.4.32. Solvent extraction of lubricating oils using a mixture of 25–50% of *ortho*chlorophenol, 70–40% of *para*chlorophenol and 15–10% of phenol.

L. Liberthson. U.S.P. 2,138,868, 6.12.38. Appl. 2.10.34. Process of lowering the pour point of lubricating oils containing wax by subjecting the waxy oil in the form of a thin film to the action of ultra-violet radiation of 2800 Ångström units at temperatures below the b.-p. of the oil and blending with a non-irradiated waxy oil.

G. H. Hutchins and A. W. Hartigan. U.S.P. 2,139,161, 6.12.38. Appl. 6.4.36. Refining lubricating oils by means of adsorbent earths in order to produce commercially useful asphalt and spent adsorbent.

E. G. McFarland. U.S.P. 2,139,240, 6.12.38. Appl. 24.11.36. Solvent refining of hydrocarbon oils using furfural.

F. W. Breth and A. Kinsel. U.S.P. 2,139,668, 13.12.38. Appl. 3.6.36. Extraction of Pennsylvanian oils with acetone.

R. R. Wilson, E. K. Brown and F. L. White. U.S.P. 2,139,871, 13.12.38. Appl. 6.8.37, and M. R. Fenske and W. B. McCluer. U.S.P. 2,139,943, 13.12.38. Appl. 13.7.34. Solvent extraction apparatus for lubricating oils.

E. J. Martin. U.S.P. 2,140,161, 13.12.38. Appl. 14.11.34. Manufacture of lubricating oils from waxy petroleum distillates by dewaxing and treating the dewaxed oil with concentrated H_2SO_4 at $-10°$ F. and separating the sludge also at this temperature.

J. S. Wallis and C. T. Chave. U.S.P. 2,140,342, 13.12.38. Appl. 23.2.34. Vacuum distillation of lubricating oils.

E. Terres, E. Saegebarth, J. Moos and H. Ramser. U.S.P. 2,140,485, 13.12.38. Appl. 22.5.35. Refining asphaltic mineral oil by dissolving it in dichlorodifluoromethane, removing the undissolved asphalt, chilling the mixture to dewax, removing the wax, and extracting the solution with a selective solvent in which dichlorodifluoromethane is not wholly miscible.

E. B. Hjerpe and W. A. Gruse. U.S.P. 2,141,085, 20.12.38. Appl. 2.11.34. Decreasing the viscosity/gr. constant of petroleum lubricating oils by extraction at 0–100° F. with a mixture of ethylene dichloride and liquid SO_2.

E. Terres, J. Moos and E. Saegebarth. U.S.P. 2,141,143, 20.12.38. Appl. 25.10.37. Dewaxing lubricating oil using tetrabromoethane and an auxiliary solvent such as benzol.

E. W. Thiele and B. Ginsberg. U.S.P. 2,141,257, 27.12.38. Appl. 28.5.36. Improvement of the properties of steam-refined lubricating oils which have been deasphalted by means of propane at 100–115° F. by adding ¼–2% of reduced pressure tar.

P. J. Harrington. U.S.P. 2,141,297, 27.2.38. Appl. 11.12.34. Method of recovering oil from petroleum acid sludge.

S. Pilat and M. Godlewicz. U.S.P. 2,141,361, 27.12.38. Appl. 13.4.37. Dewaxing hydrocarbon oil by means of cresol.

C. C. Buchler and S. H. Diggs. U.S.P. 2,141,511, 27.12.38. Appl. 17.2.36. Solvent extraction of oil using ββ-dichlordiethyl ether and 2–20% of diethylene glycol.

W. B. Hendry and L. W. Cook. U.S.P. 2,141,605, 27.12.38. Appl. 2.4.37. Solvent refining of lubricating oils using as solvent tetrahydrofurfuryl acetate and a halogenated acetic acid.

H. B. Setzler. U.S.P. 2,141,622, 27.12.38. Appl. 8.10.34. Solvent dewaxing and simultaneous acid refining of lubricating oil containing an insufficient quantity of sludge-forming substance. Still residue is added to the oil, the mixture is chilled to dewax, and then treated while still cold with H_2SO_4 in order to produce a sludge adapted to aid the separation of wax from the oil.

V. I. Downey. U.S.P. 2,141,623, 27.12.38. Appl. 22.4.37. Production of lubricating oil from Pennsylvanian crude oil by first reducing the viscosity and creating unsaturates or reactive substances by slightly cracking the oil. These unsaturates and reactive substances are removed together with the wax by chilling and the oil is then acid-treated. The oil is separated from the sludge, and blended with other oils to produce various commercial grades of lubricating oils.

Le R. G. Story. U.S.P. 2,141,626, 27.12.38. Appl. 5.2.37. Solvent refining of hydrocarbon oil by means of a non-alcoholic solvent in which the emulsification occurring during the extraction and separation into phases, is inhibited by adding a metal soap of a higher fatty acid. W. S. E. C.

Special Products.

336. Patents on Special Products. Brimsdown Chemical Works, J. C. Liddle and H. Meyer. E.P. 496,942, 5.12.38. Appl. 3.6.37. Production of active carbon by heating vegetable—*e.g.*, wood charcoal and nut-shell charcoal to at least 700° C. and subjecting to the action of a mixture of steam and air.

Standard Oil Development Co. E.P. 496,966, 9.12.38. Appl. 10.6.37. Manufacture of stabilized hydrocarbon polymers derived from *iso*butylene, of mol. wt. above 14,000.

E. I. Du Pont de Nemours & Co. and V. F. Hanson. E.P. 497,234, 14.12.38. Appl. 14.6.37. Manufacture of carbon black by electrothermal decomposition of liquid hydrocarbons.

G. W. Johnson. E.P. 497,427, 16.12.38. Appl. 16.6.37. Conversion of compounds containing acetylene into olefine linkages by treating them with an aqueous suspension of zinc which is activated by Cu and Cd. W. S. E. C.

Detonation and Engines.

337. Variation of Certain Combustion Factors in Internal Combustion Engines. M. Précoul. *Rev. Comb. Liq.*, Aug.–Sept. 1938, **16** (157), 237–240.—Various curves are given in connection with flame propagation, relation between pressure and volume of gases and volume distribution. The curve $p = f(t)$ is stated to be of particular interest as it gives information on the surface front of the flame which in turn is partly related to the speed of combustion. The most important factor brought out by these curves is propagation speed of the flame whose variation agrees in all respects with the area of the front of the flame from the point of view of engine performance. All experimental work bearing on the shape of the chamber is directed towards obtaining a maximum flame propagation speed after the flame has covered one-third of its course from the commencement of combustion. Although the curves $V = f(d)$ do not appear to have any direct bearing on the construction of engines they allow the calculation of the best volumetric yield of the explosion chamber. Thus, from the above two curves it is possible to obtain complete information about the performance and output of an engine. M. M. L.

338. Effect of Sparking-plug Material on Octane Rating. F. Fischer and H. Pohl. *Brennst.-Chemie*, 15.12.38, **19** (24), 458–460.—Results are given of tests carried out in an I.G. knock-testing engine on the effect of sparking-plug design and material on knocking. Tested plugs had three electrodes of ample section machined from the body proper thereby eliminating welded or riveted joints to take full advantage of the high heat conductivity of the metals used. With copper as a body and electrode material, the octane number of the fuel in use was improved from 54·7 observed with a standard plug, to 58·5. This plug gave satisfactory service during the two hours of test. Similar results were obtained with a mica plug equipped with Cu electrodes, the octane number improvement amounting to 2·6 units. With brass as electrode material, the effect was less, while aluminium and lead had no effect at all. L. R.

See also Abstract No. 301.

Coal and Shale.

339. Possibility of Solvent Extraction of Phenols from Coal Tar. G. Agde and H. Schuerenberg. *Brennst.-Chemie*, 15.12.38, **19** (24), 457–458.—The possibility of extracting low boiling phenols from coal tar by washing with organic selective solvents has been investigated. Tests were carried out with acetone-water, formic acid-water, and petroleum ether–methanol mixtures, and it was found that, contrary to previous assertions, it is impossible to obtain oil-free phenols in one single operation. L. R.

340. Patent on Coal. A. Pott. U.S.P. 2,141,615, 27.12.38. Appl. 30.11.35. Extraction of carbonaceous material with liquid solvents—*e.g.*, tetraline and phenol. W. S. E. C.

Economics and Statistics.

341. Report on Heavy-Oil Engine Working Costs (1937–1938). H. V. Stead, W. S. Burn, L. Hotine, C. Green and W. H. Skinner. *Diesel Eng. Us. Ass.*, Pubn No. S.149.—A summary is given of the working costs of the diesel plant run by 75 different undertakings, representing a total of 337 engines. Such factors as fuel and lubricating-oil consumption, and engine renewals are discussed, while much additional information is given in tabular form.

Comments sent in by the contributing members are also included. J. G. W.

BOOK REVIEWS.

Applied Geophysics in the Search for Minerals. By A. S. Eve and D. A. Keys. Third Edition. 1938. Pp. 316. Cambridge University Press. Price 16*s*.

The development of geophysical methods of prospecting is of the greatest importance to the mining and oil industries, and the geophysicist to-day is a very essential link between the geologist and the engineer.

The disharmony between the surface and underground formations has been the cause of many expensive failures in the past, but to-day, thanks to the efforts of the geophysicist, the test borehole can be located in the most favourable position.

The vast alluvial plains are being thoroughly combed by the geophysicist, and many great discoveries have already been made.

Those interested in the subject of applied geophysics will find lucid accounts of the various methods in the Third Edition of this book by Eve and Keys. It is one of the few books in English on this fascinating subject. The authors clearly have expert knowledge of some of the methods, particularly of the various electrical methods of prospecting for ore. Indeed, the part of the book dealing with these methods contains very valuable contributions to geophysical literature.

It is five years since the appearance of the previous edition, and in this new volume some minor modifications have been made and a chapter added dealing with the chief advances during the past years. Attention may be directed to Schlumberger's "electrical coring" for exploring uncased borings for oil; the ratiometer methods of electrical prospecting; and the improvements in the magnetic, resistivity and seismic methods of exploration. Although the chapters on the seismic and gravity methods are perhaps not as authoritative as the others, the student of geophysics will find much useful material on these methods.

The book is very well written, and it will appeal to the expert and the student alike.

J. H. Jones.

The Examination of Fragmental Rocks. By Frederick G. Tickell. Pp. x + 154. London: Oxford University Press. California: Stanford University Press. 1939. $4.00.

When Professor Tickell's book was first published eight years ago its prefatory notice adduced as a reason for its appearance, the widespread interest taken in its subject-matter by workers in many different fields of applied physical science.

This interest has not diminished with the lapse of time and a new edition has been long overdue. The new volume now appears as a revised version, with the chapter on Porosity and Permeability entirely rewritten, the bibliography brought up to date, and with certain alterations in the original text.

These changes have increased the size of the book by 27 pages while its former price has, *mirabile dictu !*, been reduced by 20%.

As explained in the preface to the first edition, the purpose of the book is to bring together in one volume the best of those investigative methods which have been developed in a variety of specialized fields, so that they could be of common interest and utility to the workers in all of them.

In the introductory chapter there is given a list of seventeen typical substances which the author considers could be profitably examined or tested by the physical methods which he describes.

This list includes such divergent materials as sands for moulding and glass-making, ceramic raw materials and products, Portland cement, building stones, oil and water sands, crystalline chemical compounds and rotary drilling muds.

The physical attributes of those materials with which the author proposes to deal are only seven in number and six of these are dealt with in the first two chapters and include the size and shape of grains, considered under the general heading of Size Analysis, porosity and permeability (dealt with in a separate chapter), density and state of aggregation.

The last subject is however only considered very briefly at the end of the chapter on size analysis, the two pages involved being confined to practical methods for preparing specimens for subsequent examination by transmitted or reflected light. Actually this appears to be misplaced in the book, since there is a later chapter entirely devoted to the preparation of specimens.

The seventh attribute, which the author refers to as "mineral content," constitutes the larger portion of the whole volume, and deals with the identification of the minerals likely to be found in the commoner rock fragments.

The chapters on size analysis, porosity and permeability are admirably put together and provide all the essential information and descriptive detail relative to current methods without unnecessary verbiage. The section on water classification might with advantage have been extended so as to include elutriation methods which the author dismisses in favour of the method of undisturbed settling. This omission is remarkable in view of the fact that elutriation has come to the fore within recent years for large-scale classification in many of the industries specifically mentioned by the author.

The A.P.I. tentative method for the determination of permeability is quoted and discussed at some length (five pages), the author pointing out at the conclusion that the necessary apparatus is expensive to construct because of the necessity for an air compressor and subsidiary appliances. He then mentions that methods have been developed in modern foundry practice for the determination of permeability to air of moulding sands, and refers to a portable and inexpensive instrument of this type designed by himself. Unfortunately he disappoints the reader by omitting a description of this instrument.

The three chapters dealing with the identification of minerals provide an excellent example of intelligent omission of non-essential details. Within the range of ninety-one pages there is compressed as much practical and essential information as would commonly be found in a book of twice its size.

The separation of minerals by panning, heavy liquid concentration and by magnetic, electrostatic and dielectric methods, occupies thirteen pages and is accompanied by useful tables and illustrations, some of which provide information which is not available in even recent editions of contemporary text-books on petrological methods.

The sections devoted to optical properties and the practical use of the petrographic microscope are essentially practical and sufficiently comprehensive for the purposes set forth as within the range of the book. A section on the construction and interpretation of orientation–cleavage diagrams is a useful feature which is illustrated by two pages of clear illustrations.

Recent improvements in spectrographic instruments have enabled an increasing number of chemists, mineralogists and metallurgists to utilize the spectroscope as an accurate and convenient instrument for analytical purposes. The inclusion of a short account of the modern methods of spectrographic examination in the book is therefore apposite and their application for the identification of such minerals as beryl, cassiterite or titaniferous magnetite is described by the author.

To sum up, this is a book which can be highly recommended as a concise and eminently practical handbook which should prove of great interest and utility to petroleum technologists in many branches of their profession.

The printing, illustrating and binding of the volume are beyond reproach with perhaps the solitary exception of the last table which is in such small print that it is practically useless as a medium for ready reference. This drawback is further intensified by the use of numerous abbreviations, the key to which is in still smaller print.

J. McConnell Sanders.

Alcool Motor e Motores a Explosao. By E. Sabino de Oliveira. Pp. 356. Instituto Nacional de Technologia, Rio de Janeiro. 1937.

Published under the auspices of the Brazilian Ministry of Labour, Industry and Commerce, this book summarizes the results of some six years of study, carried out in the laboratories of the San Paulo Polytechnic School, and the National Technological Institute at Rio de Janeiro.

The object of these studies and the events which preceded them are explained in a preface, occupying eleven pages, by Dr. Fonseca Costa, Minister of Agriculture to the San Paulo government, to whose initiative is largely due the interest taken by the Brazilian Government in the attempts to find a substitute for gasoline as a fuel for internal combustion engines.

It is pointed out that the conclusion of the Great War left in many nations a deep sense of their dependence upon exterior sources for their vital necessities

in motor fuel. France is credited with the initiation of a search for a petroleum substitute within her own frontiers, and her example was soon followed by Germany, Italy, Sweden and other countries.

In Brazil, where petroleum had not yet been discovered in commercial quantities, great interest was displayed in the French proposal to utilize alcohol, although a powerful opposition campaign was being waged, alleging that the acids resulting from incomplete combustion attacked and corroded the motors, while its low calorific value made it a poor substitute for gasoline.

As far back as 1923 experiments to prove or disprove these allegations were made, and in August of that year a Brazilian engineer, Mr. Heraldo de Souza Mattos, carried out a practical demonstration before the Brazilian Automobile Club, using a Ford car fuelled exclusively with alcohol, which successfully completed an allotted course of 230 kilometres.

It was not until 1931 that a governmental decree enacted that importations of gasoline into the country should have at least 5% of nationally produced alcohol added prior to consumption, this decree permitted the use of 96% spirit, since anhydrous alcohol was not then available.

The manufacture of dehydrated spirit, as well as a careful study of many technical problems involved in its application, constituted a subject for investigation by the Institute of Sugar and Alcohol, created in 1933 to co-ordinate the work of the Commission for the Defence of Sugar Production with that of a Commission for the Study of Alcohol Motors, created in 1931.

The experiments made in 1923 had been carried out in the Experimental Station of Fuel and Mining, and this establishment was in 1933 re-named the National Technological Institute and, acting under the auspices of the Institute of Sugar and Alcohol, proceeded to study the application of anhydrous alcohol as a motor fuel.

It was in this connection that the author of the present work carried out the investigations which form its subject matter.

In the introduction to his book Mr. Sabino de Oliveira pays handsome tribute to the work of the British Empire Motor Fuels Committee, whose reports he characterizes as "jewels of clarity and precision," even affirming that previous to their publication absolute confusion marked the state of knowledge relative to the alcohol motor. He also refers with high appreciation to the masterly work of Ricardo in England, of Dumanois in France and Calcavecchia in Cuba.

The work is divided into two parts; the first, occupying 242 pages is purely technical while the second is said to be a fifty-six-page *résumé* of the last chapters of the first rendered in language intelligible to the non-technical reader.

The first two chapters deal somewhat sketchily with thermodynamic principles, the gas laws and molecular dissociation. In the third chapter, which extends to ninety pages, Carburation and Carburettors are considered in great detail and in a somewhat original manner. The humorous illustrations on pages 58 and 59 seem a little out of place in this part of the book in view of the explanatory note on page 25.

The succeeding chapter on Detonation gives an excellent summary of the various factors which affect this phenomenon, although the greater part of the data presented is of a generalized nature, culled from the publications of well-known authorities, with little reference to alcohol.

There is an interesting remark on page 168 to the effect that prior to 1930 a compression ratio of 5·1 : 1 was considered a maximum for gasoline engines, and that the Brazilian Government had included in one of their decrees a clause which was favourable to the use of automobiles equipped with engines having a compression ratio greater than 6 : 1. This decree was based on the idea that the owners of such engines would be unable to utilize gasoline alone, and would thus be influenced to adopt blends of the same with alcohol.

In Chapter V the possibility of corrosion in alcohol motors is dealt with, as well as the alleged tendency of such fuel to denude the cylinder walls of lubricant.

The author concludes, both on thermochemical grounds and as a result of actual experiments, that the formation of acetic acid is impossible, although he admits that corrosive effects may be traceable to other causes than the use of alcohol.

The sixth and seventh chapters discuss respectively the solubility of gasoline

in alcohol and the behaviour of inflammable liquids in the explosion type of motor. The final chapter of this part of the book deals with the necessary adjustments which should be made to an engine in order that it may function efficiently with gasoline–alcohol blends. This chapter is of particular interest, since it gives the details of actual experiments carried out with various types of carburettor and of automobile engines, as well as comparative results with straight gasoline and blends of the latter with alcohol.

The second part of the book scarcely fulfils the spirit of the note which heads its first chapter, in that only a small part of it is devoted to a *résumé* of the first part, and moreover its pages are replete with curves which might quite easily prove formidable to the lay reader.

The latter will however appreciate the practical issue involved in the formulation of three types of gasoline–alcohol blends, and the information given in each case relative to its characteristic effect upon the motor as regards, power, consumption, acceleration and knock tendency.

In conclusion it may be stated that the book constitutes a well reasoned and adequate series of arguments in favour of the adoption of alcohol as an ingredient for motor fuels, and as such should be acceptable and instructive to readers in its country of origin. The work is well printed and the illustrations, which are numerous, are excellent.

J. McConnell Sanders.

Statistical Year-Book of the World Power Conference. Number 3. Data on Resources and Annual Statistics for 1935 and 1936. Edited, with an Introduction and Explanatory Text, by Frederick Brown, B.Sc. (Econ.). Pp. 138. The Central Office, World Power Conference, 36, Kingsway, London, W.C. 2. 1938. Price 20*s.* net.

The primary object of the book under review is to publish only comparable international statistics of power resources, development and utilization in conformity with the aim and definitions of the World Power Conference.

The book is divided into five sections. The first section gives a clear statement of the scope and meaning of the statistics and includes the definitions adopted by the World Power Conference. Section 3c includes the petroleum statistics, and section 4*f*, natural gas.

The responsibility for ensuring that the statistics presented are accurate, and conform to the definitions adopted by the World Power Conference, rests upon national committees, government departments and other organizations which supplied them. The particular sources of information are mentioned at the end of each table, in copious notes.

The book contains statistics on solid, liquid and gaseous fuels, water power and electricity. The liquid fuels include *petroleum*, benzoles and alcohols; gaseous fuels include *natural gas* and manufactured gas.

There are more than fifty tables in this volume, all of which are self-explanatory.

The statistics of petroleum resources and also the annual refinery statistics presented in Tables 9 and 10, are, unfortunately, incomplete. A certain amount of additional information could have been inserted in the tables, had it not been expressed in units different from those adopted by the World Power Conference, for example, the statistics for refined petroleum.

Table 14 gives the world's natural gas resources and production in millions of cubic metres. It includes the number of dry and wet wells drilled and those producing natural gas.

Table 15 gives the total production of gas accounted for, the quantity treated for the recovery of natural gasoline, the manufacture of carbon black and for industrial and household uses.

It is interesting to note that Roumania began producing carbon black in 1935 on a small scale, using one million cubic metres of natural gas for this purpose, which increased to 18·2 million cu. m. in 1936. In no other country in the world is carbon black recorded as being manufactured from natural gas other than U.S.A. where more than 8000 million cu. m. were used for this purpose in 1936.

Mr. Frederick Brown of the London School of Economics is to be congratulated for the clear and thoroughly practical way in which he has presented the results of this survey of the World Power Resources. It is through no fault of his that

the petroleum statistics are so scrappy and incomplete. The National Committees of the World Power Conference are wholly responsible for this. They should see that the additional information relating to petroleum is forthcoming in conformity with the definitions laid down for these international statistics for the next Statistical Year-Book. W. H. CADMAN.

Proceedings of the Rubber Technology Conference, 1938. Pp. 1137. W. Heffer, Cambridge. Price £2 2*s*.

In view of the magnitude and world-wide importance of the rubber industry it is somewhat surprising that no international conference on this subject had been staged until last year. In 1938, however, the Council of the Institution of the Rubber Industry were able, as a result of over a year of active preparation, to organize in London a conference of the first magnitude which met with a magnificent response and was an unqualified success.

The Proceedings of this Conference have now been published in a volume of 1137 pages containing 103 separate papers and the consequent discussions, as well as a brief report on the social functions associated with the Conference.

The scope of the Conference included the whole range of rubber technology, so that the papers cover an extraordinarily wide variety of subjects. Some of these, of course, are of specialized interest, as they deal with such topics as the production and testing of latex and raw rubber and of various manufactured articles, such as tyres, elastic textiles, rubberized fabrics and cables. Many, however, while referring in the main to rubber and its products, are of more general scope as well, and may be read with interest and advantage by chemists and physicists engaged in other lines of work. Papers on synthetic rubber-like materials such as Neoprene and the Bunas, on carbon blacks, on the absorption of oxygen by rubber, the use of inhibitors and anti-oxidants and the development and utility of accelerated ageing tests are only a few examples of contributions to knowledge which have special applicability to the petroleum industry. Furthermore, those contributions in which physical methods such as *X*-rays, fluorescence, colloid examination and various forms of mechanical testing are described, contain many fruitful suggestions for physical chemists and for engineers, and are well worth perusal.

An excellent index, plentiful diagrams and an exceptionally good quality of paper and binding make the volume a valuable acquisition both for reading and for reference. F. B. THOLE.

BOOK RECEIVED.

Standard Specifications for Benzole and Allied Products. Second Edition. 1938. Pp. 197. National Benzole Association, Wellington House, Buckingham Gate, S.W. 1. Price 7*s*. 6*d*.

With the increasing interest in the production of benzole from coal the new edition of "Standard Specifications for Benzole and Allied Products," just published by the National Benzole Association, provides comprehensive data most necessary to those whose business is concerned in any way with the production and use of benzole and its allied products.

The seventeen standard specifications now issued, which cover various grades of benzole, toluole, xylole, coal tar solvent naphtha and coal tar heavy naphtha, are the result of a thorough revision of all specifications by a Committee of the Association representative of the Benzole Industry. This committee, in collaboration with the British Standards Institution, has taken into consideration the requirements of both the manufacturers and users of the various products.

In addition to the detailed specifications, full information as to standardized methods of test and schedules of apparatus are given. The methods of testing and descriptions of apparatus are those recommended by the Standardization of Tar Products Tests Committee issued in its recent publication "Standard Methods for Testing Tar and Its Products."

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Geology.

342. Bottom Sediments of Lake Pontchartrain, Louisiana. R. A. Steinmayer. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 1–23.—Situated in the south-east corner of Louisiana, Lake Pontchartrain originated from the Gulf of Mexico by a delta finger of the Mississippi River connecting with the mainland and enclosing a portion of the Gulf between the finger and the mainland. In shape, apart from an easterly lobe, the lake is irregularly elliptical. In this lobe it still maintains connection with the Gulf through its tidal channels, which in some places are over 90 ft. deep.

Environmental changes have been common—from mixed continental to marine. These changes, however, have not always been uniform in progression, and marked variations in character and distribution of sediments and associated life have consequently arisen.

The effect of climatic conditions is discussed—*e.g.*, rainfall, winds, hurricanes, and tides; reference is also made to the relation of sediments to streams and crevasses.

The methods and devices employed in collecting samples (totalling approximately 1000) are described, together with their subsequent treatment.

The relation of organic content to texture is, in general, high organic content where texture is fine, and low where texture is coarse. G. S. S.

343. Stratigraphic Features of Reef Ridge Shale in Southern California. S. S. Siegfus. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 24–44.—The Reef Ridge shale is here restricted to a distinct lithologic unit, essentially the same as the "caving blue shale" of the Kettleman Hills, which for the most part is only about 300 ft. thick. Field work indicates that the upper and lower contacts of the formation are gradational at the type locality, having regard to the original definitions of the adjacent formations.

From the work of R. M. Kleinpell and others, the Reef Ridge shale is taken to be Upper Miocene in the middle and lower parts. The age of the upper is not known with certainty, but it is presumed in general to be transitional between the Pliocene and Miocene, these terms being employed in California at the present time following B. L. Clark's general classification.

Owing to the character of the sediments and deficiency of fossils, the upper contact of the formation in a number of areas in the central part of the southern San Joaquin Valley is uncertain. It is therefore suggested that the arbitrary line at the top of the vaguely fissile silty grey shale be taken as the upper contact of the formation in this area. G. S. S.

344. Subsurface Stratigraphy of Santa Maria Valley Oil-field and Adjacent Parts of Santa Maria Valley, California. C. R. Canfield. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 45–81.—The Santa Maria Valley, which covers about 130 sq. miles, lies in the north-western corner of Santa Barbara. The oil-field is near the centre of the valley, and is over seven miles long (east and west), and one to two miles wide (north and south).

The formations in the Santa Maria Valley include: Recent, Pleistocene, Pliocene, Miocene, and the so-called "Franciscan" basement rock of ? Cretaceous age. It is from the Miocene that oil production is obtained. Two divisions of this formation are recognized: the Upper Miocene Santa Margarita (?), and the Middle Miocene Monterey.

The Santa Margarita (?) consists essentially of silty shales—10 ft. or less to more than 200 ft., and silty sands with a maximum thickness of at least 300 ft. Other than a few indeterminable foraminifera, the deposits are unfossiliferous.

The Monterey can be divided into seven lithologic and faunal units—viz., "Arenaceous" zone, Cherty zone, Bentonitic-Brown zone, Buff and Brown zone, Dark Brown zone, Oil Sand zone, Siltstone and Shell zone (bottom). The thickness of the Monterey in the area varies from a few feet to more than 5000 ft., but in the field proper its maximum thickness seldom exceeds 1200 ft.

Structurally the Santa Maria Valley is a syncline trending generally east and west, the oil-field itself being located on the north homoclinal flank of the structure. Two generalized cross-sections across the field are given in the paper.

At the present time there are about 130 wells in the field that either are being

produced or are ready to produce. Estimated potential production of these wells is 100,000 brls. or more per day. Potentials of individual wells varies from 25 to more than 5000 brls. per day of 12–17·5° gravity crude. G. S. S.

345. Visit to Russian Oil Districts. H. G. Kugler. *J. Inst. Petrol.*, 1939, **25**, 68–88.—A paper describing the geological characteristics of Russian oil-fields west of the Urals, the Caucasian districts, and the Dugheatan region, and containing pertinent maps and diagrams. G. R. N.

346. Search for Oil in France and her Colonies. Anon. *Rev. Pétrolif.*, 10.2.39 (824), 169–170.—The Saint-Loup well lies between two lines of oil-seeps and is in the hard Domerian limestone at a depth of 283 m. The well at Pézenas was abandoned without attaining its objective. At a depth of 1153 m. it passed from the dolomites into the black Posydonomya marls. A further test is required on the northern flank of this anticline, and this should penetrate the whole of the Trias.

The El Haroune well in Tunis is now in blue marl at a depth of 1687 m., and the Zaouia well has reached 766 m. The Rhazouane well is in very hard shaly marls at a depth of 820 m., having found signs of oil at 150 and 749 m. In French Equatorial Africa the Yeno well drilled to determine the succession has been stopped at a depth of 1003 m. Three structures are being examined geologically.

Well No. 5, on the Ambohidranomora anticline in Madagascar, has reached a depth of 900 m. It found impregnated beds at 308 and 313 m., but in spite of the good cover the oil was very heavy.

Morocco is still the main field of oil search. The infra-Liassic test at Dahar N'Sour is at 435 m. The Djebel Harricha well has been continuously in the Miocene to a depth of 1047 m. The Bou Mimoun well showed an aqueous emulsion with a sulphurous odour and accompanied by inflammable gas, at a depth of 1002 m. The Mohammed Chleuh well has reached 102 m., and the Karia well 303 m. The latter gave a slight show of gas in a faulted zone at 263 m., and a core had traces of oil which were not, however, geologically important.

Bou Draa No. 23 was taken to 225 m. in the Toarcian, but the marker limestone was faulted out as in No. 19. No. 24 reached the productive horizon at 159 m., whilst No. 21 was in the Toarcian at 318 m., and in an attempt to bring it in 21,750 lit. of oil were obtained in seven days.

Tselfat No. 40 was drilled to find the south-eastern extent of the oil horizon, and efforts to bring it in yielded 10,940 lit. of oil in four days. Other tests have been drilled.

It is estimated that an output of 4000 tonnes of oil per annum is obtainable from the beds already discovered. A pipe-line has been constructed from Tselfat to Petitjean, and further geophysical prospecting equipment has been acquired. The costs of the search are given. G. D. H.

347. Search for Oil in Midi, France. Anon. *Rev. Pétrolif.*, 20.1.39 (821), 77–78.—After the Castelnau-de-Guers well near Pézenas was stopped at a depth of 1154 m. without having reached the base of the Jurassic, a well was begun at Mortiés, 25 km. north of Montpellier. This well, which is to test the Trias, has encountered red rocks (almost exclusively massive limestones). The Gorniés well has penetrated clays, arkosic sandstones, sandstones, variegated clays, and cavernous dolomites, and at a depth of nearly 500 m. a strong water flow has been met. A well is to be drilled near Madières.

The oil production at Gabian is still falling.

In the Petites-Pyrénées a deep well is to be drilled on the Saint-Marcet–Saint-Martory anticline, to test the Cretaceous, which is several thousand metres thick in that region. Farther west, on the Roquefort anticline, a well will be drilled. G. D. H.

348. Large-Scale Oil Search in Egypt. Anon. *Petrol. Times*, 14.1.39 (1044), 44–47.—The revision of the Mining Law has led to a rush for exploration permits. The names of the applicants and the extent of their holdings are given, whilst maps show the positions of the permits.

Aerial surveys, torsion balance and gravimetric surveys, core drilling, and geological work have been carried out jointly in Sinai, the Western Desert and on the Red Sea coast, by the Anglo-Iranian and Royal Dutch–Shell groups. At Ras Gharib three successful wells have been completed with an oil production of about 600 tonnes/day. This is a geophysical success.

The Socony–Vacuum Oil Co., Inc., holds permits on the Red Sea coast and in North Sinai. The gravity meter, torsion balance, and reflection seismograph have been employed in addition to geological surveying. A test well at Dishet el Dhaba on the Red-Sea coast was dry. The other companies have also carried out geophysical work.

G. D. H.

349. Progress of "D'Arcy Exploration" British Oil Search. Anon. *Petrol. Times*, 28.1.39 (1046), 110.—A well is to be drilled at Eakring between Newark and Ollerton, Notts., to test the Carboniferous, the base of which is estimated to lie at a depth of 3000–3500 ft. This location has been chosen following prolonged geological and geophysical work, and is 7½ ml. from Kelham, where two wells drilled in 1923 found several shows of oil and gas.

In the south, where the company has abandoned fifteen areas covering 2715 sq. ml., the only activity is a geological bore at Chaldon Down.

Cousland No. 2 well near Dalkeith is in the Oil Shale group at a depth of 1000 ft. A site for No. 3 has been chosen about 2 ml. from No. 1. The latter has a potential yield of 10,000,000 cu. ft. of natural gas/day. Shallow bores are to be drilled in the Pentland area to ascertain if oil accumulation is possible below the Pentland fault. In Fife structural bores have been drilled prior to selection of a location for a deep test to the Oil Shale group.

The Hardstoft well has been deepened, gun-perforated, and treated with solvent and acid. While the results are encouraging, it is not yet possible to determine what the sustained production is likely to be.

The Gun Hill (Staffs.) well is at a depth of over 4500 ft., and in the Lower Carboniferous. The prospects of obtaining oil in it are now remote. Gas has been encountered in Eskdale No. 2 in Permian limestone at a depth of 4212 ft. G. D. H.

350. Alberta's New Status in Empire Oil Picture. J. L. Irwin. *Petrol. Times*, 21.1.39 (1045), 78–80.—In spite of drastic proration in the last three months of 1938, the year's production was probably well in excess of 7,000,000 brls. This was a marked increase on the 2,075,338 brls. of 1937. Steps have been taken for the conservation of gas pressure and the necessary legislation has been introduced. Owing to market limitations proration was introduced in September 1937, and has operated at varying levels since then.

It is expected that Home No. 2, 2½ ml. north-west of Model No. 1 at the northern end of the Turner Valley, will be a major producer. The Blackfoot–Ribstone well, about 30 ml. south-east of Wainwright, has been brought into production on an encouraging scale at a depth of 2034 ft., yielding 24° Bé. oil. The North Taber Royalties No. 1, 30 ml. east of Lethbridge, has encountered seven gas sands, and the Ram River well, 100 ml. west of Red Deer, has shown gas and oil impregnation. Other developments are: Altoba on Clearwater River, 20 ml. south-east of Ram River well; Pouce Coupe wells near Alberta–British Columbia boundary in the Peace River country; Home-Brazeau well in Brazeau area; Banner well in Highwood area south of Turner Valley; test at Steveville 70 ml. north-west of Medecine Hat; Moose Dome 30 ml. west of Calgary; two wells near Lundbreck in Crowsnest Pass area; and Milk River and Del Bonita in the international boundary area. G. D. H.

351. Roumanian Oil-field Developments in 1938. Anon. *Petrol. Times*, 4.2.39 (1047), 143.—In 1938 the Roumania oil production was 8% below that of 1937, and the drilling activity was 29% below that of the previous year.

It has now been agreed to embark upon unit operation at Tintea.

The Runcu wildcat found only salt water, but that at Magurele found oil, and has given a maximum of 50 tonnes of oil/day with some salt water. Its electrical log shows other promising sands at less depths. The Draganeasa wildcat reached a depth of 1455 m., and during a short test gave 49 tonnes of oil/day, with casing-head and

tubing pressures of 94 and 74 atmospheres, respectively. The Bucovina wildcat was a failure.

It is hoped that a new Mining Law will be drawn up which will meet all the requirements of the producers and yet safeguard the interests of the State. The State may undertake some exploration on its own account. G. D. H.

352. Problems in Australian Oil Search. Anon. *Petrol. Times*, 14.1.39 (1044), 52–53.—At Foster's bore in the Lakes Entrance area in East Gippsland, large volumes of water with some oil were pumped from glauconitic sands in the Oligocene. The maximum daily recovery of dehydrated oil was about 200 gal. To examine the conditions in this area the Imray bore was drilled, which showed that the oil sands were free from water and that the water-bearing beds were below them. The oil sands had no natural pressure to drive the oil to the wells. Hence no commercial production was possible in the Lakes Entrance area by merely drilling wells and pumping oil therefrom. The recovery by using the underlying water to flush out oil was not worth while. Other means of oil recovery have been under consideration, but there are many difficulties and no guarantee of success. The oil content of the sands, estimated at 150 million gallons, is, however, sufficient to justify some attempt being made to extract it. Such an attempt calls for the expenditure of much money, the efficient plugging of all old wells, and treatment of the whole area as a unit for air repressuring.

G. D. H.

Geophysics.

353. Importance of Geophysics in the Discovery of Petroleum Deposits in U.S.A. S. von Thyssen-Bornemisza. *Oel u. Kohle*, 1939, **15**, 113–117.—A review of the expenditure on, and the results obtained by, geophysical research in the United States between 1924 and 1938 is given under the four main divisions: seismic, torsion-balance, magnetic, and gravimetric research. Particular attention is paid to the Gulf Coast district of Texas and Louisiana, and a list of all oil-fields discovered in this area since 1926 is given in chronological order, together with that branch of geophysics which was used in the discovery of each particular field. T. T. D.

354. Maximum Electromagnetic Damping of a Reluctance Seismometer. N. R. Sparks and P. F. Hawley. *Geophys.*, 1939, **4** (1), 1–7.—The mathematical determination of the response of an electromagnetically damped reluctance seismometer is difficult because the equation of motion is a third-order equation. Explicit solutions of these equations can be obtained only in special cases. The case dealt with in this paper is that of maximum damping, and the relations between the seismometer constants in that circumstance are determined. It is emphasized that the analysis applies only to an ideal seismometer, and hence the results obtained should be regarded merely as a qualitative guide to performance. S. E. C.

355. Seismic Paths and Velocity–Time Relations. M. Mott-Smith. *Geophys.*, 1939, **4** (1), 8–23.—Calculations are based usually on the assumption that the seismic paths are straight. Where the reflecting beds are deep and the dip gentle, there is little error in this assumption, but where the beds are shallow and the dips steep, or where the velocity varies rapidly with depth, the curvature errors are large. In the latter case it is necessary to find an equation which will fit the observed velocity curve and yet, at the same time, be amenable to analysis. Three types of simple velocity–depth laws have generally been assumed in the investigation of seismic paths: the parabolic type without initial velocity, the parabolic type with initial velocity, and the exponential type. These are considered fully and rejected, because either they do not conform sufficiently closely to empirical velocities, or the difficulties of fitting are too great. On the other hand, the velocity–time curve of the parabolic type with initial velocity can be used successfully. A further advantage of this curve is that in the majority of cases the velocity measurements depend on observations of time, and hence it is nearer to the original observations than the velocity–depth curve. Also, if the velocity–time curve is a good fit, then the fit will be better on the velocity–depth curve.

There are two methods of using the seismic paths and the wave-fronts so obtained:

dips and depths may be derived from them directly, or corrections may be obtained for the dips and depths calculated on the straight-line assumption. The former method is ideal if the curve is a good fit with the empirical velocity, but when it is not, the second method involves less error. S. E. C.

356. Steady State Polar Sensitivity Curves. C. H. Johnson. *Geophys.*, 1939, **4** (1), 33–52.—In this paper the case is limited to steady state, sinusoidal waves, and a horizontal line of uniformly spaced geophones. There is discussed first the cumulated amplitude of waves given by the geophones as a function of the number of geophones used and of the phase difference between the waves at the extreme geophones. This relationship is illustrated graphically, and it is shown that each curve repeats itself in a definite period. Whilst maximum sharpness of the primary maximum of the curve is obtained by coupling only two geophones, there is little decrease in sharpness when more than three to four are used, and the larger number has the advantage that the principal maxima are more widely spaced and more marked in relationship to the others. The relative response of the geophones to waves from different directions is then illustrated by means of polar sensitivity curves. The sharpest response for vertical arrivals is obtained by using as many geophones as possible, with a geophone spread of $(N-1)^2/N$ times the wave-length, where N is the number of geophones. For waves arriving at fairly high angles, reasonable response is obtained by keeping the geophone spread small, but this involves a sacrifice in the sharpness of the primary polar loop which still points downward. If a sonograph is used, however, it is possible to vary the direction of maximum response at will, and at the same time obtain considerable reduction in the response to all other directions of arrival, including the vertical.
S. E. C.

357. Frequency Response of Electromagnetically Damped Dynamic and Reluctance-Type Seismometers. D. Silverman. *Geophys.*, 1939, **4** (1), 53–68.—The working system of a seismometer for the reflection method must be very selective to frequency, and consequently it is necessary to determine its frequency response. The system comprises the seismometer proper, the amplifier, and the recorder, and the response of each unit must be known. The use of a specially designed steady-state shaking-table has rendered the determination of this characteristic of the seismometer simple and rapid.

In the case of the dynamic seismometer it is shown that the experimentally determined response is identical with that given by mathematical analysis. The frequency response of a balanced armature reluctance-type seismometer is more difficult to analyse mathematically, since it involves a third order equation. It is shown, however, that measurements with this instrument on the shaking-table confirm conclusions regarding the shift of the response peak to higher frequencies when the terminal resistance is decreased and regarding the value of the resistance for maximum damping.

It has been found that the steady-state response of the reluctance-type seismometer does not agree with that of Washbourne's equivalent circuit. This is because the latter does not take into account a number of small losses in the actual instrument. By designing a circuit which takes these into account, and comparing the response of this circuit with the response on the shaking-table of the corresponding seismometer, good agreement was found. Thus for steady-state measurements the shaking-table can be used to obtain the seismometer response, although for transient measurements the equivalent circuit is still very useful. S. E. C.

358. Reaction-type Shaking-table. D. Kelly. *Geophys.*, 1939, **4** (1), 69–75.—Measurement of the response of filters, amplifiers, and recorders is simple, but in the case of the seismometer or of the system as a whole it is very difficult. A steady-state shaking-table was therefore made in order to simplify this problem. The table consists of a 500-lb. mass suspended on coil springs packed with felt, with a natural frequency of 2 cycles per second. An eccentric, driven by an electric motor, is the source of vertical motion of the table, and is mounted with its axis at the centre of percussion of a short pendulum pivoted to the bottom of the table. In this manner rocking of the table is avoided. The motor is shunt-wound and battery-driven, and has good speed regulation

between 600 and 9000 r.p.m. The amplitude of motion of the table-top is independent of frequency over the range 10 to > 150 cycles per second. S. E. C.

See also Abstract No. 348.

Drilling.

359. Surface Chemistry of Clays and Shales. A. D. Garrison. *Petrol. Tech.*, Feb., 1939, A.I.M.M.E. Tech. Pub. No. 1027, 1–14.—Alumino-silicates, despite their chemical complexity, fall into three simple structural groups: fibrous, micaceous, and framework. In clays and shales the micaceous type predominates. The structure of clay minerals is indicated.

Water may be retained by clay minerals in three ways: (1) crystal water, (2) broken bond water, (3) planar water. The first is held firmly in the crystal structure; the second is attached to the broken edges or rims of the micaceous structures. Planar water is not held rigidly, but by weak electrostatic forces along the tops or bottoms of the flat plates of the micaceous minerals. This water causes swelling and shrinkage of the clay. The plates attract water more strongly than they attract each other.

The colloidal alumino-silicic acids are relatively strong acids. The clays undergo base-exchange, and the sodium ion escapes from the clay more easily than the hydrogen ion, making the sodium clay more strongly ionized, giving a higher total negative charge on the micelle or anion, and therefore a more stable suspension.

Examination of bentonite suspensions shows that the ultimate strengths of the gels increases as the p_H value increases. There is a tendency for the rate of gelling to fall off up to about p_H 10, and to rise thereafter. This behaviour is characteristic of all the colloidal minerals of clays and shales. Sodium tannate treatment reduces the rate of gelling but not the ultimate strength. The same is true if the calcium or magnesium ions are replaced by sodium. The gelling data are discussed in terms of Smoluchowski's theory of the formation of colloidal aggregates.

Some aspects of the application of the surface chemistry of clays and shales to drilling problems are described. G. D. H.

360. Sulphate-resistant Cement. S. Rordam and C. Willson. *Petrol. Tech.*, Feb., 1939, A.I.M.M.E. Tech. Pub. No. 1029, 1–3.—The tricalcium aluminate, one of the components of Portland cement, is the component which reacts most readily with sodium or magnesium sulphate solutions, leading to destruction of the hardened cement. It is established that if it forms only 0–3% of the cement, the cement is almost immune to such attack, but when it is present to the extent of 4–5%, failures can be expected.

Highly corrosive natural ground-waters are to be expected in drilling wells. It has been proved by laboratory tests that their corrosive action is less the higher the temperature.

While sulphate-resistant cements may not develop as much strength early in the hardening process as high-early-strength or standard Portland cements, later this type of cement will develop an equally high or even higher strength.

Cement affords an excellent protection against possible electrolysis causing disintegration of casing. G. D. H.

Production.

361. Typical Oil-field Brine-conditioning Systems; Preparing Brine for Subsurface Injection. S. S. Taylor, C. J. Wilhelm and W. C. Holleman. U.S. Bur. Mines, Rep. Invest., No. 3434, Jan., 1939, 1–71.—The disposal of oil-field brines by injection into subsurface formations other than fresh-water-bearing strata is a positive method of eliminating the harmful effects of mineralized water on fresh-water supplies, vegetation, and aquatic and other animal life. The method is still in the experimental stage, but a number of more or less successful types of brine-conditioning systems and methods of treatment have been developed. One of the major problems is the clogging of the formation in the disposal well, and much attention has been paid to this problem. Injection of brines into oil-producing formations to increase the ultimate recovery of oil has been successful in some areas, and has afforded a means of disposing of the

brine produced with the oil. Furthermore, where secondary recovery of oil by water-flooding is practised, operators often have found fresh-water sources inadequate to furnish water enough for the flooding purposes, and have been compelled to drill wells into brine-containing formations to obtain a volume of water sufficient to promote their flooding projects.

The report contains a detailed description of the construction and operation of some typical brine-conditioning and disposal systems. The data include the chemical and corrosive characteristics of brines before, during, and after conditioning in various types of systems for subsurface injection. The so-called closed, open, and semi-closed types of systems which are used to condition the sour (hydrogen sulphide-bearing) brines, as well as the more stable brines containing iron in solution, are discussed. The brines prepared for subsurface injection by the conditioning systems were produced with oil from four formations—Arbuckle (Siliceous) limestone of Cambro-Ordovician age, the Kansas City limestone and the Burbank sand of Pennsylvanian age, and the Wilcox sand of Ordovician age. The brines from these formations, and especially that produced from the Arbuckle limestone, present specific problems in brine-conditioning for subsurface disposal. The report contains complete descriptions and histories of the brine-injection wells. Cost data, furnished by several of the operators, are included to indicate the cost of processing brine for subsurface disposal by several experimental brine-conditioning systems.

There are fifteen figures and nineteen tables. G. D. H.

362. Development and Production Problems in High-pressure Distillate Pools. E. V. Foran. *Petrol. Tech.*, Feb., 1939, A.I.M.M.E. Tech. Pub. No. 1023, 1–9.—A distillate pool is one in which at the time of discovery the products in the reservoir exist wholly or mainly in the gaseous phase. In some places the whole reservoir is filled with wet gas containing water-white condensible products, but apparently with no dark oil or other hydrocarbon liquids in the reservoir. In others the wet or distillate-bearing gas may form a large gas-cap directly overlying and in contact with an extensive reserve of dark oil. The heavier components of the deep pool gases are generally water-white, and mainly condensable in a conventional oil and gas separator under pressures of the order of 400–600 lb./in.^{2}. These may have end-points of 650° F. or more on standard Engler distillation. It is possible that small amounts even of the dark components may be in the gaseous phase when the temperature is 300° F., and the pressure exceeds 6000 lb./in.^{2}.

The condensable portion may range 0·45–4·4 gal./1000 cu. ft. of gas, the amount varying with the conditions. The thickness of the gas-saturated sections of the deeper distillate pools have ranged from 15 to 400 ft. When the pressure of the reservoir is lowered, condensation occurs. The low proportion of condensate entails that any condensation which takes place in the reservoir other than that at the immediate well-bore will not be recoverable except by methods of induced secondary saturation by means of recycling residue gas.

The relative values of the residue gas and recoverable condensable products vary greatly among the pools. The well-spacing for a distillate property should be virtually the same as for the conventional " dry " gas pool, except that high-pressure maintenance is required by recycling residue gas. The amount, and not the rate of pressure decline, is the controlling factor in reservoir condensation. In completing a well a minimum-pressure gradient adjacent to the bore should be aimed at. The pressure drop from reservoir to separator should be low.

The fresh-water condensate ranges from 1 to 3·5% of the condensable hydrocarbons in the separators, and a higher proportion is precipitated before reaching the surface. The input wells should be remote from the producing wells. Over-drilling will not increase the recovery. The initiation of recycling late in the life of a pool may be ineffective. For success unit operation of the pool is essential. G. D. H.

363. Design for more Effective Proration. J. E. Pogue. *Petrol. Tech.*, Feb., 1939, A.I.M.M.E. Tech. Pub. No. 1028, 1–9.—As now constituted, proration is a planned production measure designed to prevent waste, insure rateable takings, and balance supply and demand. It is controlled by legislation. Formerly it was a temporary measure adopted when production outran the absorptive power of the market. It

is now a permanent measure. The rule of capture became unworkable under modern technological conditions, and proration developed as an off-setting and neutralizing influence. It is justified as a fundamental conservation measure.

To get the maximum oil recovery the reservoir energy must be used most efficiently. Conservation can be attained by any system of operation that restrains the flow of the oil-pool to the most efficient rate, and enforces rateable takings among the competing operators in the pool. Probably the best view of reservoir energy is that it is a force to be conserved until virtual exhaustion of the oil.

Under the practice of proration, entirely apart from the application of market demand quotas, a significant by-product of economic stability is inevitable. The difference between the aggregate production rate of our oil-fields and market demands is not substantial; consequently proration can de directed so as to approach a plane of natural equilibrium between demand and a supply restricted according to engineering principles. Steps are indicated for a more successful outcome of proration technique. These include consideration of optimum rates of production, rateable takings, drilling rates, market demand quotas, and the preservation of flexible markets.

G. D. H.

364. Core Analysis. H. C. Pyle and J. E. Sherborne. *Petrol. Tech.*, Feb., 1939, A.I.M.M.E. Tech. Pub. No. 1024, 1–28.—The following factors are examined: permeability, porosity, grain size, and fluid content. The data so obtained are of importance in estimating the amount of recoverable oil on water-flooding and in predicting the productivity in flush fields. Certain precautions are necessary in sampling, and mud, oil, and water samples also are desirable. The sample should be divided into three parts: one for the fluid content, one for permeability and porosity, the other for salinity.

The permeability specimen is leached with hot carbon tetrachloride and dried with hot air. The measurement should preferably be made parallel to the bedding planes. This specimen is subsequently used for determining the porosity.

A sample is heated in a retort at 400° F. for 40 min. to drive off most of the oil and water. It is then heated at 1100° F. for 20 min. The condensate is collected in a special centrifuge tube, and the sand is weighed on cooling. Corrections are made for the fluid losses in the retort and condenser, for cracking, and the loss of carbon dioxide and water of crystallization from the sand-grains.

The details of the permeameter are described. For porosity, the bulk volume is determined by mercury displacement, after which the sample is disintegrated and the grain-volume measured by displacement of tetrachlorethane. To find the salinity a dried disintegrated sample is shaken with a known volume of water. 50 c.c. of the filtrate are neutralized and then titrated with silver chloride. Oil may be washed from the sand with chloride-free solvent before drying, and the drying temperature should not be much above 200° F. The grain-size distribution is determined by screening.

Curves have been prepared showing the relationship between the gravity of oil before and after retorting. The gravity of the dried oil is measured in a special small pycnometer or by a capillary-rise method.

Many of the measured physical characteristics of sandstone and its fluid content are inter-related—*e.g.*, connate water and permeability; salinity and resistivity log; residual oil with oil expulsive and resistive forces.

Graphical representation of the data is desirable. Reconstruction of the total fluid content of a sand permits the type of production to be predicted, and the probable rate of production of oil to be estimated. Practical examples are given to illustrate the application of the data—*e.g.*, the fixing of liner specifications and estimation of reserves.

G. D. H.

365. Effect of Pressure Reduction on Core Saturation. H. G. Botset and M. Muskat. *Petrol. Tech.*, Feb., 1939, A.I.M.M.E. Tech. Pub. No. 1025, 1–12.—To get a core to the surface so that original fluid content is undisturbed is so far impossible. Hence it is necessary to discover its relation to its undisturbed state. Questions of contamination of the core by drilling mud water are not considered in this research. A given core was filled with fluid (gas and oil, gas and water, or gas, oil and water) at

the desired pressure. The pressure was then reduced to atmospheric at a suitable rate, after which the final liquid saturation was determined. All the determinations were made by weighing, the surface of the core being wiped free of excess liquid. The following factors were varied one at a time—porosity of core, permeability, nature of liquid (or liquids) and gas, saturation pressure, and rate of pressure reduction.

The porosity was determined by liquid saturation. In the saturation experiments water and carbon dioxide or kerosine and carbon dioxide or natural gas were used. To saturate the core it was placed in a holder and the pores were filled with gas by repeated filling under pressure and subsequent expansion. The liquid saturated with the desired gas was then allowed to enter the core slowly under a pressure slightly in excess of the saturation pressure. Finally the pressure on the core was reduced to atmospheric at the desired rate.

With water and carbon dioxide the final saturation of Berea sandstone for saturation pressures of 100–800 lb./in.^{2} averaged 65%. Using kerosine and natural gas at pressures of 1700 lb./in.^{2} the final average was 76·9%. Generally a rate of pressure reduction of 15 lb./min. was used, corresponding roughly to the rate of withdrawal of a core barrel in a well.

For water, gas and oil, the water was introduced by capillarity and the gas-saturated oil by the ordinary method. The results showed that it is possible to have a water saturation of 60% and still have no water expelled when the pressure was reduced at the rate of 15 lb./min. Moreover, the final total liquid saturation was essentially the same, regardless of the amount of water initially present in the core, *e.g.*, the higher the water saturation, the larger the percentage of kerosine which was produced. This is significant with regard to production. The absolute pressure of saturation did not greatly affect the results.

The higher rates of pressure decline resulted in greater oil recoveries, for the higher-pressure gradients involved are able to overcome the surface tensional forces in a larger number of pores than can the lower-pressure gradients.

Bringing a core up a well is nothing more than permitting a small sample of the reservoir to go through its complete production history. However, the pressure gradients involved are very much higher than would occur in a producing sand; but the technique is of interest with regard to predicting ultimate recoveries when rates of pressure decline are kept low. For such purposes actual field materials should be used. G. D. H.

Transport and Storage.

366. Determination of the Probable Life of Line Pipe. S. Thayer. *Petrol. Engr*, Jan., 1939, **10**, 81.—Based on data obtained over 20 years of experience with several pipe-line systems comprising several thousand miles of line, a curve is drawn relating percentage of replacement against age of line in years. Extension of this particular curve indicates that all the original line will have been replaced at the end of 44 years. Differences in location, wall thickness, and in the nature of the protective covering utilized will naturally have marked influences on the actual slope of the curve for a given line, but it is suggested that, from the known history of replacements to date, a similar curve can be drawn for each case. Likewise curves of probable developments of leaks can be constructed. Such curves may be utilized to advantage in planning the future protection of lines and the amounts which should be replaced or protected annually for the most economical operation. R. A. E.

367. Inconsistencies in Calibration of Tankship Cargo Tanks. R. H. Rogers. *Petrol. Engr*, Jan., 1939, **10** (4), 29.—In the ullage and sounding tables supplied to a tankship, the heights of the various tanks are subdivided into increments of $\frac{1}{4}$, 1, 3, or 12 in. These increments vary from tank to tank, depending on such factors as shape, position in ship, and type of contents. The usual practice is to use small increments where the shape of the tank is changing rapidly and large increments in that portion of the tank where the shape is more or less akin to a regular geometrical solid. The usual custom is to work for a relative accuracy of 2–3 parts in 10,000—*i.e.*, comparing the total calculated volume of the tank minus internals with the volume obtained by adding the increments of a plotted curve such as the barrels-per-inch curve. There is, of course, no absolute guarantee that the volume calculated from mould loft offsets is

the actual volume of the tank. It is contended that ullage readings spaced every inch are just as nearly accurate as those spaced every ¼ inch, and at the same time the calibration costs will be reduced by approximately 50 per cent. The effects of minor variations in dimensions during erection of the steel structure of a ship, the deflection of the structure of the tank under hydrostatic load, and the effect of the temperature changes on the steel-tank structure itself, are considered. It is shown that the latter factor, which is neglected in practice, is of major importance, and that in the case of a tank 35 ft. × 40 ft. × 40 ft. a change in temperature of 10° F. causes an error in volume about equal to the tank's capacity per inch of depth. The combined effects of the other factors are estimated to be on the average of a similar order. It is concluded that ullage tables tabulated in increments of 1 in. are therefore adequate.

R. A. E.

368. Storage Tanks. Clemens. *Oel u. Kohle*, 1939, **15**, 89–96.—In the early days of the industry, when kerosine was the most important product commercially, no attempt was made to reduce the loss of lighter fractions on storage. With the growing importance of gasoline, the necessity of reducing this loss became urgent. The author deals with the attempts to do this by perfecting a gas-tight roof, incorporating valves through which vapour may be forced out, and air drawn in, as the tank breathes. He illustrates, with diagrams and typical numerical examples, the stresses and strains produced both as a result of expansion and contraction of the material of the tank, and of the rise and fall of vapour pressure of the contents, brought about by fluctuating air temperature.

Dealing with safety precautions, the author outlines the methods of construction adopted to allow the roof to be blown off without seriously damaging the remainder of the tank, should an explosion take place. The protection afforded to neighbouring tanks by spraying with water in the event of another becoming ignited is discussed, and the author suggests that in many cases this treatment may actually increase the danger to the tanks concerned.

The author confines his paper to tanks which are wholly above ground, and in which the contents are stored at atmospheric pressure with a vapour space above the level of the liquid.

T. T. D.

369. Corrosion and Protection from Corrosion of Storage Tanks for Petroleum Fuels. F. Eisenstecken and H. Roters. *Oel u. Kohle*, 1939, **15**, 129–137.—Pure anhydrous ethanol attacks only magnesium and lead, and can therefore be stored in steel tanks. Occasionally corrosion results if fermentation by-products have been incompletely removed. Methanol attacks a number of metals, and the degree of attack by mixtures of ethanol and methanol is proportional to the content of the latter.

A diagram is given showing the loss in weight of galvanized-steel test-pieces immersed for 6 months in aqueous alcohols of varying water content. The attack of methanol, increases rapidly with increasing water content, whilst that of ethanol increases only very slowly. A second sample of ethanol containing acetaldehyde behaved very similarly to methanol. A series of experiments confirmed this, and showed that the acetaldehyde is produced when ethanol is left in contact with air, water, and zinc. It is concluded that galvanized or black-iron plate is not a suitable material for the construction of tanks used in the transport of commercial alcohol, and stated that success in practice has been obtained by coating the inner surface of the tank with tin or a lacquer. A number of inhibitors are listed which markedly reduce the corrosive properties of alcohols, but with stationary storage tanks it is usually considered unnecessary to take any special precautions.

Pure hydrocarbons are not corrosive, but petroleum fuels contain sulphur compounds and unsaturated products which oxidize to corrosive substances, giving rise to high- or low-molecular-weight acids in varying circumstances. A review of tests for corrosive sulphur is given, and results are quoted showing that for a gasoline of given sulphur content, corrosion in diminishing degree is caused by elementary sulphur, sulphur and mercaptan, H_2S, ethyl mercaptan, and CS_2, the last two causing only slight corrosion. It may be said that, in general, anhydrous benzol, toluol and xylol, and sulphur-free gasoline do not attack base metals at ordinary temperatures. Cracked fuels are more corrosive, often owing to the presence of sulphuric acid esters, which are not completely removed when the fuel is distilled.

Admixture of ethanol to commercial gasolines and benzols does not increase corrosiveness except in the presence of water. Results of Bauer and Schikorr are quoted dealing with the increasing attack on aluminium and its alloys by mixtures of ethanol with commercial gasolines and benzols, as the water content is increased.

Since it is impracticable to remove the corrosive components from the fuel, attack can only be reduced by having a corrosion-resisting material for the tank. Stainless steels are expensive, so an inner protective coating is to be preferred. This must be both chemically resistant and of good elasticity, in order to withstand shocks in transport. For this purpose use has been made of tin, zinc and, more recently, lac films stable to gasoline. An investigation into the stability of such a film was carried out, and a table of results is given. Unfortunately, the formation of the most highly impervious films requires a high temperature, a factor which reduces the elasticity of the film, and so the production of a lacquer film with high imperviousness and good elasticity is awaited to make this method of paramount importance for transportation tanks.

The chief cause of corrosion in ships' tanks is the alternation between petroleum and sea-water carried as ballast, as has been confirmed by laboratory tests. Many suggestions have been made in the literature and in practice, for the protection of ships' tanks, without much success. A number of these are quoted, and the authors favour, for crude or heavy oil transport, galvanization provided that the oil contains only very small quantities of salts soluble in water.

The paper concludes with a short survey of the conditions existing and precautions taken in practice, in which it is stated that in the case of fixed storage tanks, in general, no protective coatings are employed. T. T. D.

Cracking.

370. Cracking Gaseous Hydrocarbons in the Spark Discharge. T. Amemiya. *J. Fuel Soc. Japan*, 1938, **17** (195), 99–108.—Methane, ethane, propane, the butanes, and the corresponding olefins were decomposed in the spark discharge (*ca.* 50,000 volts and 100 kilocycles). High yields of hydrogen and acetylene were obtained. The summarized results were as follows :—

1. The rate of decomposition of the sample increased with the current intensity and the heating or reaction time.

2. The yield of acetylene per reacted molecules proportionally increased with the velocity of flow, and inversely with the heating or reaction time and decomposition rate.

3. Hydrogen as well as carbon monoxide had a favourable effect on the yield of acetylene, by virtue of decreasing the formation of carbon. Nitrogen had no effect, and carbon dioxide, oxygen, or steam reduced the yield of acetylene.

4. The concept of " free radicals " was found applicable to describe the course of the reaction mechanism. G. R. N.

371. Small Combination Cracking Unit. J. C. Albright. *Refiner*, 1939, **18**, 49–52.—A 1050-brl. crude skimming unit at Leuders, Texas, has been converted to a 1400-brl. crude distillation cum two-coil Dubbs cracking unit without the addition of another heater. The crude is charged at 32 lb. pressure, and, by means of heat exchange with cracking unit streams, is supplied with sufficient heat to operate a salt-settling unit and also flash off in the primary tower straight-run gasoline, kerosine, tractor distillate/gas oil. The reduced crude ex the primary tower is charged to the cracking-section fractionator, from which light oil and heavy oil streams are taken and passed through the original heater revamped to contain light-oil and heavy-oil coils. The flow after leaving the heater is the conventional for a two-coil unit. A particular feature of the plant is the unequal size of the plungers of the hot oil pump to accommodate the different volumes of light and heavy oils. The possibility of " jerkiness " in the operation of the pump is eliminated by carrying different pressures on these streams. Transfer line temperatures are 905° F. and 1010° F. for heavy and light oils, respectively. The stabilized cracked gasoline has an octane number of 71 for an end-point of 396° F. Fuel requirements average about 1·7% of the crude charged. The cost of erection was around $90,000. G. R. N.

372. **Modernization of Cracking Plant.** J. J. Loudermill, J. L. Gaskell, C. H. Alberding, and B. J. Flock. *Oil Gas J.*, 2.2.39, **37** (38), 42.—A Dubbs unit in a Louisville, Ky., refinery of the two-coil selective-cracking type has been modernized by the addition of coking equipment and other improvements, enough fuel oil being produced for market requirements, and the remainder being coked. The coke is an excellent fuel for tobacco drying and other industrial uses, as well as for domestic heating. Two coking-chambers are interposed between the reaction-chamber and the flashing-unit, each having a capacity of 55 tons—one day's production. Coke removal is by the cable method, occupying 4 hours. Operating details are given, together with yields and properties of products obtained during a 70-day continuous coking run on topped crude. A yield of 60·58% of gasoline of O.N. (M.M.) 69·5 was obtained, together with 10·79% of residuum, 16·89% of coke, the gas and loss figure being 11·74%.
C. L. G.

373. **Patents on Cracking.** Standard Oil Development Co. E.P. 498,094, 3.1.39. Appl. 19.11.37. Catalytic refining of oil by preheating the vapour to 750–1000° F. and passing it through a bed of activated, natural, or synthetic clay until the catalyst shows substantial deterioration. The catalyst is then regenerated by treatment with regeneration gas (steam or flue gas) with or without admixed air at 1200–1300° F.

P. H. Gilkerson. U.S.P. 2,144,109, 17.1.39. Appl. 5.3.37. Improved coke chamber for cracking operations.

W. H. Carmody. U.S.P. 2,143,474, 10.1.39. Appl. 3.11.36. Treatment of higher boiling oils contained in pure still residues from the fractionation of cuts of coke-oven light oils at 265° C. with 2% of aluminium chloride. A mixture is obtained of benzol, toluol, xylol, and naphtha and a resinous material. W. 8. E. C.

Hydrogenation.

374. **Destructive Hydrogenation of High Molecular Weight Olefin Polymers.** H. I. Waterman and J. J. Leendertse. *J. Inst. Petrol.*, 1939, **25**, 32–40.—Experiments are described on the destructive hydrogenation at 435° C. of Alchlor polymers of *iso*butene and *cyclo*hexene, and the products thereby obtained are characterized by the authors' method of analysis, which indicate the latter unsaturate gives the more stable polymers.
G. R. N.

375. **Application of Reaction Kinetics to Process Design. Hydrogenation of *iso*Octene.** L. S. Kassel. *Industr. Engng Chem.*, 1939, **31**, 275–277.—The kinetics of catalytic hydrogenation of *iso*-octene to *iso*-octane is developed both for ordinary flow conditions and for two- or three-stage operation with counter-current flow between the stages. The case of ideal counter-current flow is also developed, since it represents the limit of multi-stage operation. The general conclusion reached from the calculations is that two-stage operation is justified by the increase in plant capacity, but that only minor increases in efficiency are produced by increase in the number of stages. Curves are given which show the effect of changing the hydrogen ratio, as well as the number of stages. H. E. T.

378. **Patents on Hydrogenation.** M. Pier and A. Eisenhut. U.S.P. 2,144,409, 17.1.39. Appl. 8.11.35. Method of separating solid constituents from charging oil for use in hydrogenation processes.

V. Ipatieff and V. Komarewsky. U.S.P. 2,145,657, 31.1.39. Appl. 30.12.36. Hydrogenation of hydrocarbon oils at 150–400° C. and at 10–100 atms. pressure, using as catalyst an alkali metal aluminate and a metal sulphide corresponding to hydrogen sulphide the hydrogen atoms of which have been replaced by a metal.

N.V. de Bataafsche Petroleum Mij. E.P. 498,859, 16.1.39. Appl. 16.7.37. Catalytic dehydrogenation of non-aromatic organic compounds—*e.g.*, non-tertiary alcohols—into the corresponding carbonyl compound, or of *iso*- or normal butane into the corresponding unsaturated hydrocarbon, using as catalyst a metal-alloy tube con-

taining activated alumina and heated to 500–800° C. Sulphuretted hydrogen is passed through the tube for a time, so as to poison the interior surface of the tube and to render it substantially inactive to catalyse the carbon formation during the reaction.

A. H. Boultbee. U.S.P. 2,143,472, 10.1.39. Appl. 20.7.36. Catalytic dehydrogenation of hydrocarbon distillates containing naphthenes and paraffins.

W. S. E. C.

Polymerization.

377. Gas Purification and Polymerization at Wilshire. J. C. Albright. *Refiner*, 1939, **18**, 41–44.—At the Norwalk refinery of the Wilshire Oil Co. 15,120 brls./day crude oil are processed in a skimming unit to give light gasoline, reformer naphtha, and reduced crude. The latter is charged to a Dubbs unit, and yields gas, gasoline, and fuel oil. The stabilizer gases from the cracking and reforming units amount to around 2,000,000 cu. ft./day and contain 33·3–35·7% unsaturates. These gases are processed in a potassium triphosphate unit to remove hydrogen sulphide then processed in a U.O.P. catalytic polymerization unit to yield 7 galls. polymer gasoline per 1000 cu. ft. charged. The polymer gasoline so obtained represents 2·2% of the crude, and the total gasoline—*i.e.*, light straight-run, cracked, reformed, and polymer gasoline—amounts to 60·38% of the crude, and has an octane number of 70–72 for an end-point of 390° F.

By employing suitable stabilizer pressures, the use of compressors for both the H_2S removal and poly units is unnecessary. A standard type of absorption column is used to contact the tripotassium phosphate and cracked gas, and the spent reagent is revivified by steam treatment and recycled. The expelled H_2S is burned at the plant flare. Five catalyst columns (36 in. diam., 30 ft. effective height of catalyst bed) are employed in the poly unit, and the catalyst, when spent, is regenerated by the standard method of controlled burning. Over a period of 7 months the average olefin conversion was 88%. The cycle time of a column is 800 hrs., and approximately 10% of this period is required for catalyst regeneration. G. R. N.

378. "Sarmiza" Process for Producing High Octane Fuels and Aromatic Hydrocarbons. Anon. *Rev. Pétrolif.*, 5.8.38 (797), 1001–1004.—Paraffinic hydrocarbons can be converted by a heat treatment in four separate stages into highly aromatic gasolines. The process can be applied to petroleum fractions or synthetic hydrocarbons boiling between 150° and 350° C.

In the first stage, at about 300° C., the initial product is completely gasified. In the second stage, at 500° C., the gas is cracked to gaseous olefins. In the third stage, at 600° C., polymerization and cyclization of olefins to *cyclo*-olefins are carried out. The latter are dehydrogenated to aromatics in the last stage at 720° C.

The process operates without pressure or catalyst, and has the advantage that individual stages are completely independent of each other, each proceeding in a separate furnace and, consequently, enabling accurate control of single phases of the process. The process has been used on a semi-technical scale in Bucharest for two years. Results are claimed to be almost uniform, and no coke and only little gas are formed.

The gasoline yield averages about 60% of the initial product, it contains 80% aromatics, and has an octane number between 92 and 95. Owing to the small olefin content, the gasoline is stable in storage. Further properties are given in tabular form. The process can also be applied to synthetic oils of the Fischer–Tropsch process (Kogasin II). The costs of the Sarmiza process are claimed to be low.

L. R.

379. Patents on Polymerization. G. W. Johnson. E.P. 498,526, 10.1.39. Appl. 15.7.37.—Polymerization of olefines containing not more than 30% of olefines with up to 5 C atoms and preponderating quantities of butylenes or amylenes or their mixtures, using a catalyst of the Friedel–Crafts type. The products are then hydrogenated and treated with superheated steam in the presence of caustic alkali.

Universal Oil Products Co. E.P. 499,066, 18.1.39. Appl. 30.11.37. Catalytic polymerization of olefines at 150–288° C. and under 6·8–20 atm. pressure, using a phosphoric acid catalyst.

Le R. G. Story. U.S.P. 2,142,969, 3.1.39. Appl. 28.12.36. Polymerization of cracked distillates in which the distillates are subjected to the action of a solid adsorbent catalyst. The products are fractionated to produce a stable gasoline, and the gaseous products are polymerized in the presence of phosphoric-acid catalyst.

H. V. Atwell. U.S.P. 2,145,576, 31.1.39. Appl. 29.7.37. Conversion of normally gaseous hydrocarbons into liquid products by subjecting a mixture rich in olefines in admixture with oxygen at elevated temperatures and at atm. to 100 lb./sq. in. pressure in a primary zone. The hot reaction products from this reaction zone are then admixed with a gaseous hydrocarbon mixture containing hydrocarbons with more than 2 C atoms/mol. The resultant mixture is then heated in another zone to the same temperatures, but under a greater pressure, to produce liquid products.

W. S. E. C.

Refining and Refinery Plant.

380. Filtrol Fractionation Plant. M. M. Moore and H. M. Gwyn, Jr. *Refiner*, 1939, **18**, 45–48.—At the Richmond refinery of the S.O.C. California a 1200-brl. Filtrol lube unit is in operation. A solvent-treated long residuum (98 VI and 58 SSU/210° F.) is charged, and yields three distillate pale oils and a 5 A.S.T.M. colour bright stock of 151 S.S.U./210° F. Filtrol clay is mixed with 10% of the charge in automatic equipment, and the resultant slurry is pumped into the main stream, which, after heat exchange, is raised in temperature to about 675° F. in a heater. The clay and oil are then discharged into a vacuum bubble tower and the flashed bottoms or bright stock plus clay are withdrawn from the soaking section at such a rate that the contact time at this point is 15–20 min. This mixture, after some cooling, passes via a surge tank to a continuous vacuum rotary filter fitted with a Monel metal cloth precoated with diatomaceous earth. Filtration is carried out at 300° F. A scraper edge strips the clay from the precoat earth, which must be renewed weekly. Owing to the use of heat exchange the distillate oils receive a light clay treatment prior to flashing. The amount of clay used is of the order of 1 lb. to 8 galls. of charge, whilst the loss of oil to clay is less than 1%.

G. R. N.

381. Use of Mist Extractors in Gasoline Plants. H. B. Van Emden. *Petrol. Engr*, Jan., 1939, **10**, 116.—In a plant taking casing-head gas from the field at 200 lb. suction pressure and compressing it to 400 lb., frequent shutdowns were necessary because of compressor valves breaking. This was found to be caused by cold liquid in the incoming gas striking the hot valves. Although gas in the suction line passed through a large scrubber, liquid was evidently being carried over. A mist extractor installed on the scrubber outlet collected about 1½ brls. of liquid per day, and completely eliminated the breakages. The mist extractor consists of a number of zig-zag vanes placed in the gas-stream, dividing the gas-flow into a number of thin streams. At each projecting corner of the vane is a pocket to remove collected moisture from the gas. The vanes reach into all parts of the gas-stream, collect the mist into drops, and remove the liquid completely from the gas.

Tests indicate that similar extractors placed in the discharge lines proved to be of value in eliminating freezing troubles which had been experienced in cold weather. The pressure drop through the mist extractor was shown to be negligible.

R. A. E.

382. Need for Fouling Data on Heat Exchangers. W. L. Nelson. *Oil Gas J.*, 2.2.39, **37** (38), 40.—Laboratory data on film transfer rates in heat exchangers generally show too high a value owing to the absence of films of grease and scale present in practice. As an example, increasing the velocity of kerosine through a heat exchanger by twelve times should theoretically increase the transfer rate by 125%, but in practice in dirty equipment an increase of only 33% is given. With more viscous stocks the effects of dirty exchangers are considerably magnified, so that the transfer rates are controlled more by the state of the equipment than by the viscosity of the product.

C. L. G.

383. Distillation in the Petroleum Industry. J. Schmit. *Rev. Pétrolif.*, 25.11.38 (813), 1517–1519.—Physical data of importance in distillation are discussed, including (1) specific heat, (2) specific volume, (3) vapour pressure, (4) latent heat of vaporization, and (5) equilibrium constant (ratio of mole fraction in liquid).

In a pipe still heat input in the radiant heat zone is usually between 30,000 and 60,000, and in the convection section between 11,000 and 25,000 Cal./sq. m. hr. The temperature of the stack gases is 100–200° C. higher than that of the oil charge. Oil velocity within the tubes varies between 0·8 and 250 m./sec. For determining the flash-curve the author refers to methods given by Pircomov, Beiswenger, Nelson, and Sanders. The flash-curve can also be used in estimating oil-vapour condensers. The heat transmitted is calculated as :

$$Q(\text{Cal./hr.}) = H.\,S.\,\Delta t,$$

where H = heat transfer coefficient (Cal./sq. m. ° C.), S = the surface of the heat exchanger (sq. m.), and Δt the mean logarithmic temperature difference.

The action of the bubble towers is explained, and the method of calculating the theoretical number of plates of absorbers and strippers given by Kremser is discussed. In practice the theoretical plate number has to be increased by 25%. The usual number of plates contained in absorbers is twenty, and in strippers three or four. Data are given on liquid level on plates, pressure drop through plate, number of bubble caps, weir and downspout dimensions, and plate spacing.

The maximum vapour velocity within the tower is given by the equation : $V = 31{\cdot}6\ \frac{T\,.\,d}{M\,.\,P}$, where T = ° C. abs., d = density of entrained liquid, M = mol. weight of vapour, and P = pressure in atm. A 30-cm. layer of Raschig rings would be equal in effect to one bubble-plate.

The further course of estimating plant and auxiliary apparatus is indicated. It is recommended to have the crude oil heated in heat exchangers to 200–250° C.

L. R.

384. Corrosion in Petroleum Refineries. J. Moinard and P. Moyne. *Rev. Pétrolif.*, 9.12.38 (815), 1581, 1582.—The various compounds of potential corrosive action in crude-distillation units are enumerated and the critical points of attack mentioned. H_2S and HCl combined have the highest corrosive effect. Condenser corrosion is best obviated by NH_3 injection controlled by p_H measurements.

In cracking, sulphur crudes cause worst corrosion. Cr–Ni steel gives good resistance, whilst plain steel is subject to heavy erosion. The calorizing process provides perfect protection against hydrogen sulphide attack.

In stabilizers and gas-treating units 20% Ni + 8% Cr steels and certain Cu-Ni alloys of the Monel-metal type give excellent results. The conditions in a plant for sulphuric-acid treatment of gasoline are discussed.

It is concluded that in view of the complex nature of the corroding media, laboratory tests are difficult to interpret. In individual cases the authors prefer to carry out an intimate analysis of the corrosion phenomenon leading to a provisional selection of materials of construction. Final decision is reached after conducting a practical test with specimens placed within the apparatus itself. L. R.

385. Corrosion Caused by Refinery Combustion Gases. P. Woog, R. Sigwalt, J. de Saint-Mars, and J. Dayan. *Rev. Pétrolif.*, 9.12.38 (815), 1582–1584.—In a refinery heavy corrosion was observed in the distribution system of purified inert combustion gases from fuel oil. Separated liquid drained at varying points from the system showed considerable nitric acid contents. Examination of the gases revealed distinct contents of nitrogen oxides, although only minute quantities of NO were present. While the former were easily eliminated by alkali treatment, the elimination of NO presented difficulties.

Tests based on the use of absorptive solutions, on oxidation followed by alkali absorption, and on absorption by a solid mixture on iron sulphide base gave unsatisfactory results. Various charcoals, however, had a good absorptive effect on nitrogen oxides with activated charcoal as an optimum. The absorptive effect was not impaired by the presence of CO_2 and SO_2. Used charcoal could be reactivated by a super-heated steam treatment.

In the course of further investigations it was found that no explosive nitrogen–hydrocarbon compounds were formed during the charcoal-absorption process. Even activated charcoal containing nitromethane did not explode when heated. Consequently, the extraction of nitrogen oxides by activated charcoal does not present any hazard. L. R.

386. Removal of H_2S from Gas Containing O_2. T. S. Bacon. *Petrol. Engr*, Feb., 1939, **10**, 70.—Various commercial processes are available for removal of H_2S from gases, but a new process has been devised in the case of residue gas from casing-head plants in the Breckenridge, Texas, area. This gas is compressed to a pressure of about 350 lb. per sq. in. prior to delivery to main distribution lines. The casinghead plants obtain gas from wells operated under vacuum, and, owing to unavoidable leakage of air, the gas entering the compressor station contains 1·0–1·8% of oxygen, in addition to 0·2–0·4% CO_2 and 1·5–4·0 grains H_2S per 100 cu. ft. Corrosion was experienced in the high-pressure mains, and it was found necessary to reduce the H_2S content to max. 0·10 grain/per 100 cu. ft. Caustic wash could not be used owing to the CO_2 present, and to reduce the H_2S content to the limit desired required a plant of high efficiency. The process finally developed involves the absorption of H_2S in an alkaline solution, and oxidation of the absorbed H_2S to free sulphur, using the free oxygen present in the gas and a catalyst of iron and zinc salts to accelerate the oxidation rate sufficiently to overcome any danger of liberation of H_2S from the solution by the air and CO_2 present. The solution is pumped continuously from a tank to the top of a concrete-lined scrubber fitted with stainless-steel trays and caps, and is returned to the same tank from the base of the scrubber. Gas enters the bottom of the scrubber through a small mist extractor. The circulation of the scrubber solution is required to remove free sulphur from the interior of the scrubber. The sulphur present in the solution separates as a foam owing to the action of dissolved gases liberated from the solution by reduction of pressure, and this foam can easily be skimmed off. The solution loses its efficiency owing to side reactions, and is replaced every 7 days. Two scrubbers are used, one after each stage of compression of the gas, so as to give continuous purification should one be shut down. Some free sulphur is deposited on the metal surfaces in the scrubbers, and must be removed manually every 90 days. The plant has operated satisfactorily for several years. R. A. E.

Fire Prevention.

387. Fire Precautions in a Petroleum Laboratory. J. S. Jackson. *J. Inst. Petrol.*, 1939, **25**, 103–105.—A short account of experience gained in the Shell Laboratories, London, on the performance of laboratory operations, with particular reference to the prevention of fires. G. R. N.

Chemistry and Physics of Petroleum.

388. Purity of High-Molecular-Weight Hydrocarbons. H. I. Waterman and J. J. Leendertse. *J. Inst. Petrol.*, 1939, **25**, 89–99.—The first of a series of papers on the critical examination of synthetic hydrocarbons of various types and of high molecular weight. This paper is mainly devoted to a criticism of Mikeska's work on this subject. G. R. N.

389. Isomerization of Heptane, Octane, and α-Hexene. A. D. Petrov, A. P. Meschcheryakov, and D. N. Andreev. *Oil Gas J.*, 2.2.39, **37** (38), 42.—A description is given of experimental work carried out in order to determine whether low-molecular-weight paraffin and olefin hydrocarbons can be isomerized without cracking or polymerization, and also the quantitative extent of isomerization at different temperatures and pressures in the presence of halide catalyst and the molybdenum trisulphide catalyst generally used for destructive hydrogenation. It was found that in general the temperature limit of isomerization is near that of cracking, and especially of polymerization of olefin hydrocarbons. Destructive hydrogenation is likely to provide a greater degree of isomerization than does reforming, whilst if the latter reaction is carried out as an isomerization by reducing the temperature with the aid of catalyst,

the loss of low-boiling fractions through side reactions of polymerization of olefin hydrocarbons is reduced. C. L. G.

390. Nitrogen Compounds in Petroleum Distillates. XIII. Isolation of Four Quinoline Homologues and Two Aromatic Bases of Probable Trinuclear Cyclic Structure. W. N. Axe and J. R. Bailey. *J. Amer. chem. Soc.*, 1938, **60**, 3028–3032.—By utilizing the fractional de-gassing of the base-acid sulphite process 2-, 3-dimethyl-8-*n*-propyl-quinoline and 2-, 3-, 4-8-tetramethyl quinoline have been isolated from the 300° range of kerosine bases.

Two bases $C_{13}H_{15}N$ and $C_{14}H_{17}N$, of undetermined structure were separated from the 295° range.

Two bases $C_{15}H_{13}N$ and $C_{16}H_{15}N$, probably of the acridine or naphthoquinoline types, have been isolated from transformer oil base fractions. T. C. G. T.

391. Nitrogen Compounds from Petroleum Distillates. XII. Fractional Sulphiting of Bases and Fractional De-Gassing of their Acid Sulphites. S. M. Roberts and J. R. Bailey. *J. Amer. chem. Soc.*, 1938, **60**, 3025–3028.—Acid sulphites of organic nitrogen bases dissociate on heating their aqueous solutions. This reaction Base + SO_2 + H_2O (Sulphiting) $\rightleftharpoons$ Base . H_2SO_3 is, therefore, reversed by de-gassing. The authors have developed fractional acid extraction during the sulphiting and fractional acid-sulphite dissociation during de-gassing, in order to resolve kerosine bases into their component types. T. C. G. T.

392. Viscosity and Constitution. G. Hugel. *Oel u. Kohle*, 1939, **15**, 27–29.—Chemical reaction is compared and contrasted with the flow of a liquid; in the former only energetically activated molecules play a part, in the latter all molecular collisions. Obviously the forces are of an entirely different order of magnitude, and the author suggests that constitution has little or no effect on viscosity.

Consider the viscosity–temperature curves of the chemically dissimilar liquids dihydrodi*iso*amylanthracene, butandiol and *n*-octane; superficially the curves are very different, but by plotting logarithmically it can be shown that they all fall on the same rectangular hyperbola of formula $(\log \eta - a)(T - b) = C$, where a and b are constant for the particular liquid, and C has approximately the same value for all three. This shows that no main difference exists between associated and non-associated liquids as far as viscosity–temperature curves are concerned.

Constitutional properties are represented by the constants a and b, of which b indicates that η becomes infinite at a temperature b above absolute zero. Taking the simpler case when $b = 0$, we may write $\eta = Ae^{Q/RT}$, which is the formula developed by Drucker and, later, Andrade, Sheppard and Raman. Compounds following the law are quoted, together with others which do not; if in the case of the former, Q is plotted against A a straight line ensues, and the author writes $A = A_0H$, where A_0 represents properties common to all liquids, and H specific properties. From this follows Dunstan's principal that $\log \eta$ is a linear function of mass, and the author's conclusion that in these liquids the molecules must be similarly arranged. Considering the aliphatic ketones, he shows that, though they are associated, the logarithmic increment between neighbouring members of the series is the same as in the unassociated aliphatic hydrocarbons, and concludes that the presence of the keto group and association cannot affect the arrangement of the molecules.

In the case of liquids which do not follow Drucker's law, and for which $b \neq 0$, plots of A against Q do not, in general, lie on one straight line, each homologous series having its own straight line. This the author interprets as signifying that the arrangement of the molecules remains similar in any one homologous series, but varies from one series to the next. T. T. D.

See also Abstract Nos. 407, 408.

Analysis and Testing.

393. Determination of Salts in Crude Oil. Part I. C. H. M. Roberts and R. W. Stenzel. *Petrol. Engr*, Jan., 1939, **10** (4), 35.—It has been found necessary to specify new and improved methods for determining the quantities of salts in crudes in order to estimate

more exactly the potential and actual improvements in refining processes due to de-salting of oil. The salts occurring in crude may include any or all the inorganic salts found in oil brines, or associated with the formations from which crude oils and the brines accompanying them are produced. They may also include inorganic acids or salts introduced into the oils and brines as a consequence of acidizing of wells, as well as finely-divided, insoluble solids dispersed in the oil. The principal things to be determined are the acidity of the oil, total solids, both water-soluble and water-insoluble, total sulphates and chlorides, and individual sodium calcium and magnesium chlorides. The importance of ensuring that truly representative samples are secured, and that portions subsequently withdrawn for analysis are also representative, is stressed. The general problem of determination of salts in crude comprises two entirely separate and distinct problems: (1) complete extraction of salts from oil, (2) estimation, in the aqueous extract, of the kinds and quantities of the various substances present. The first is by far the more difficult. In the present article a description is given of all the methods which have come to the notice of the authors, together with a discussion regarding their advantages and defects. R. A. E.

394. Determination of Salts in Crude Oil. Part II. C. H. M. Roberts and R. W. Stenzel. *Petrol. Engr*, Feb., 1939, **10**, 37.—Microscopic examination of crude oil is often informative, especially as regards presence and nature of solid materials, but cannot be substituted for quantitative analytical determinations. With the object of devising a simpler or more generally applicable method for salt extraction than those at present available, factors specially investigated were: (*a*) use of oil-soluble diluents and mutually soluble diluents, (*b*) use of demulsifying chemicals, (*c*) conditions of mixing oil and water. The only methods seriously considered as suitable for general use are those in which the centrifuge is employed for separation of the aqueous extract. Results of the individual investigations are given, and the procedure finally adopted as satisfactory for all types of oil tested was: accurately measure 50 mls. oil and mix with 75 mls. distilled water, 70 mls. xylol, 5 mls. *sec.*-butyl alcohol, and two drops of a 10% xylol solution of Tretolite L-10396. Heat mixture at 180° F. in a piston emulsifier cylinder, emulsify with fifty strokes of a tightly fitting piston, and transfer to centrifuge tubes. Rinse emulsifier with 5–10 mls. xylol, add to tubes and heat tubes for 5 mins. at 180° F. Centrifuge for 10 mins. at 1800 r.p.m. (11-in. radius of swing), siphon aqueous layer. Re-centrifuge and record volume of residual B.S. & W. in tubes, correcting the titration value for this residue. This method is known as the "Petreco Experimental Method," and its efficiency compared with those of other Petreco methods and methods proposed by Barnsdall, U.O.P., and Blair, by testing four samples of crude by all methods. Further tests were carried out on certain methods using a sample of synthetic crude of known salt content. The method can be depended on to recover at least 95% of the total salt content of an oil, and results are reproducible to 1% or 2%. By repeated extractions, the recovery can be made to approximate 100%. Another Petreco method, known as L.B., gives similar accuracy. R. A. E.

395. Determination of Neutral Oil in "Sodium Sulphonates." E. J. Boorman. *J. Inst. Petrol.*, 1939, **25**, 100–102.—The method described consists of extracting the "sodium sulphonates" with petroleum spirit after removal of inorganic salts, from solution in equal volumes of water, glycerol, and alcohol. The petroleum spirit extract is washed with aqueous alcohol and the neutral oil is obtained by evaporation of the spirit. G. R. N.

396. Acid Treatment of Cracked Gasoline. A. Newton. *J. Inst. Petrol.*, 1939, **25**, 24–31.—A paper presented at the Trinidad branch on the study of induction period as a control test in the acid treatment of cracked gasoline. It is shown that unless phenolic constituents are completely removed from re-run acid-treated Trinidad cracked gasoline, erratic results are obtained. Complete removal is ensured by treating the gasoline with an alkaline solution of an aromatic diazonium chloride. G. R. N.

397. Survey of Methods for Evaluating Carbon Blacks. I. Drogin. *Proc. Rubber Tech. Conf. London*, May, 1938. Paper No. 18, pp. 420–482.—In a description of

the methods developed for testing Channel blacks it is stated that the chemical and physical properties of the black do not correlate with the processing or reinforcing qualities of the blacks. A number of tests are in use for the determination of the physical properties of the vulcanized rubbers containing these blacks, but in many cases they are insufficiently sensitive, and do not correlate with actual performance. The sensitivity of these tests has now been increased and new tests have been added, the most important being the flexometer test, the pendulum-impact and -rebound test, a test to determine the state of vulcanization, and dielectric tests. Tables are given showing the chemical and physical characteristics of carbon blacks, the influence of each characteristic on rubber compounds, and the properties of various mixes made up with different blacks. C. L. G.

398. Low-temperature Hydrometer Method for Liquefied Gases. W. M. Schaufelberger. *Oil Gas J.*, 2.2.39, **37** (38), 37.—A rapid method is described for the determination of the specific gravity of liquefied petroleum gases, particularly suitable for use when loading tank cars. The sample is cooled by passing through a coil in a propane bath consisting of a glass vacuum flask in the case of butane, or in a CO_2-propane bath in the case of propane, and its gravity determined by hydrometer in an unsilvered vacuum flask. Low-temperature specific-gravity curves prepared from practical and theoretical bases are reproduced, and are used for the conversion of the recorded specific gravity to that at 60° F. Full details are given of the hydrometer, thermometer, and apparatus, together with tabulated data on the specific gravity of various mixtures of *N*-butane, *iso*butane propane, methane, and ethane, and of the pure components *N*-butane, *iso*butane, and propane, and of the corrections to be applied to allow for contraction on mixing of butane and propane. C. L. G.

399. Contribution to the Knowledge of the Viscous Properties of Bitumen and Natural Asphalts. J. Cságoly. *Asph. u. Teer*, 1939, **2**, 21–27.—A method is described for determining the origin of bitumen, and thus its road-making characteristics, by measuring the temperatures at which the viscosity of the bitumen assumes the value of 50 poises and 0·5 poise. These temperatures, t_1 and t_2, are used to construct a graph by plotting t_2–t_1 against t_1. The viscosities are determined using the Marschalko viscometer. Examples are given of the use of this procedure for identifying Roumanian and Mexican bitumen, for comparing bitumen extracted with CS_2 from road material with the original bitumen, and for paraffin bitumen mixtures. An extension of the use of the method is in the evaluation of bitumen mixtures from different crudes, cutbacks, and the possibility of its use for road-tar, coal-pitch, and tar-bitumen mixtures is discussed. In studying the application of the procedure to Trinidad Epuré, it was found that the ash-free, CS_2-extracted bitumen had properties which would indicate that the material was of poor quality, whereas it is known to be of high quality. This difference was traced to an alteration of structure of the bitumen during the extraction process, as the material obtained by allowing the mineral matter to settle from the heated asphalt was of good quality. Whilst it appears possible to evaluate ordinary bitumen by this method, the question of natural asphalt remains open. H. L. W.

400. Testing Bituminous Filling Compounds. K. Haufe. *Bitumen*, 1939, **9** (1), 15–22.—The author discusses the results of an investigation of methods of test for bituminous filling compounds prescribed in the instructions issued by the Inspector of the German Motor Roads. The methods are criticized on grounds of inadequate description of apparatus and test conditions, and suggestions are made for the standardization of tests for filling compounds. Wilhelmi's method for determination of softening point, in which a ring of 51·8–53·8 mm. diameter and ball of 15 mm. diameter weighing 13·7 gms. is used, gives results about 2° F. lower than the normal (R. & B.) apparatus, and is claimed to give better agreement than the latter. In the investigation of the " Ball-Flow " deformation test, the effect of varying weight of the ball of compound, temperature, and time was determined, and it is shown that better differentiation is possible with increased weight, time, and temperature. It is suggested that a smooth glass plate and the temperature of the latter at commencement of test be specified. For testing the resistance to shock at low temperature, the

"Falling-Ball" test of Hermann is preferred, but suggestions are made for improving the D.I.N. test in which the number of blows required to fracture a 50-gm. ball of the compound, with the hammer used in cement testing, is determined.

Several methods for examination of ductility and adhesion are described. These consist essentially in determining the resistance to cracking or breaking away of the compound, in the form of a joint between concrete plates, etc., when the supporting plates are drawn apart at low temperatures. Discussing the composition of filling compounds, it is stated that a proportion of medium-length fibre asbestos appears to be essential, but that insufficient data are available regarding the most suitable type of bitumen for this purpose. A. O.

401. The Report of the Institution for Experimental Work on Roads of the C.T.I. and R.A.C.I. for 1938. R. Ariano. *Le Strade*, 1939, **17**, 3–22.—The activity of the mentioned laboratory is summarized and the results of test work are discussed and reviewed. The new apparatus adopted by the laboratory, as well as those modified, are described. The various analyses carried out on cements, sands, asphalts, asphalt emulsions, and tars are then examined. The tests most frequently requested were sp. gr. penetration, softening point (B. & R.), ductility, solubility in CS_2, volatility, and paraffin content. The relationship between softening point and penetration was determined, and a curve of the viscosity–temperature type obtained. No relationship was found between ductility and penetration. Although these tests serve as an approximate indication of the behaviour of the asphalt in use, they do not adequately achieve this purpose, and new methods have therefore been investigated, keeping in mind the requirements of the constructor and the use for which the asphalts are intended. In this connection the author describes procedures and apparatus for the adhesion test, determination of asphaltenes, and Fraass breaking point. Tars are seldom used on Italian roads, and hence are rarely tested. Asphalt emulsion is the most widely used binder, road oils are rarely employed. Among the characteristics of emulsions the most frequently requested were: stability, homogeneity, and Engler viscosity; a minimum value of 5° at 25 C. is prescribed for the latter; normal tests have been determined. In this connection the author points out that the commonly used method for asphalt extraction, flocculation with 95% alcohol, and subsequent drying of the extracted asphalt, leads to a hardening of the asphalt and reduction of ductility, which is mainly due to the prolonged heating to eliminate water. Another method for the extraction of asphalt from emulsions has recently been used with good results, flocculation with 94% alcohol and elimination of water and alcohol under vacuum 64–68 cm. mercury at 90–95° C. A method of asphalt extraction from asphaltic dust has been studied which is based on vacuum extraction, thus avoiding a reaction of the sulphur, with consequent hardening of the asphalt. The author describes a method for measuring the adhesion of hydrocarbon binders to rocks, and for determining the inherent cohesion of the binders, indicating the first results obtained. P. G.

402. Patent on Analysis. G. Kent, Ltd., and J. H. Ratcliff. E.P. 498,630, 11.1.39. Appl. 14.12.37. Method and apparatus for use in measuring specific gravity. W. S. E. C.

Motor Fuels.

403. Patents on Motor Fuels. Universal Oil Products Co., E.P. 497,792, 28.12.38. Appl. 25.5.37. Alkylation of normal paraffin hydrocarbons containing 3 or 4 C atoms, with monolefines containing 3 or 4 C atoms per mole for the production of liquid hydrocarbons. The reaction is carried out at 20–75° C. in the presence of aluminium chloride and a minor amount of hydrogen chloride, and molecular excess of normal relative to olefines hydrocarbons is maintained during the reaction.

Universal Oil Products Co. E.P. 498,127, 28.12.38. Appl. 25.5.37. Process as described in E.P. 497,792, in which zinc chloride is used instead of aluminium chloride.

Universal Oil Products Co. E.P. 498,247, 5.1.39. Appl. 18.8.37. Method of increasing the anti-knock value of motor spirit by subjecting the spirit in the form of vapour at a reforming temperature above 450° and below 650° C., for 2–20 secs. The

catalyst used is precipitated and calcined aluminium hydroxide which is substantially free from occluded and adsorbed salts, and contains from 5 to 10% of water.

Universal Oil Products Co. E.P. 498,260, 5.1.39. Appl. 9.11.37. Production of alkyl derivatives of hydrocarbons of groups comprising paraffinic, naphthenic, and aromatic hydrocarbons by subjecting the hydrocarbons to alkylation with *cyclo*-paraffins having less than 5 C atoms in the ring in the presence of aluminium or zirconium chloride and hydrogen chloride at temperatures below 15° C.

Universal Oil Products Co. E.P. 498,463, 5.1.39. Appl. 5.5.37. Isomerization of normal pentane at atmospheric temperatures up to 200° C. in the presence of not more than 10% by weight of aluminium chloride and not more than 2% by weight of hydrogen chloride.

Ethyl Gasoline Corp. E.P. 498,509, 9.1.39. Appl. 18.4.37. Anti-detonant mixture containing three methyl-ethyl lead derivatives in which the concentration of lead dimethyl diethyl predominates.

Universal Oil Products Co. E.P. 498,512, 5.1.39. Appl. 5.5.37. Isomerization of normal butane at 150–200° C. in the presence of not more than 20% by weight of aluminium chloride to which some activated charcoal is added, and not more than 5% of weight of hydrogen chloride.

A. L. Lyman, H. B. Nichols, and R. C. Mithoff. U.S.P. 2,143,078, 10.1.39. Appl. 23.11.36. Catalytic desulphurization of petroleum distillates by passing the vapours at 675–850° F., together with hydrogen, over iron sulphide formed by the reaction of iron rust with organic sulphur compounds contained in petroleum distillates. The hydrogen comprises at least 2 atoms hydrogen/atom of mercaptan sulphur.

J. A. Campbell, Jr., and T. M. Phillips. U.S.P. 2,143,405, 10.1.39. Appl. 25.9.33. Cyclic process for sweetening mercaptan-bearing hydrocarbon distillates using caustic soda and sulphur in which the caustic soda is regenerated for re-use.

H. M. Steininger. U.S.P. 2,144,276, 17.1.39. Appl. 23.8.34. Treatment of hydrocarbon products—*e.g.*, motor spirit and furnace oil—to remove objectionable unsaturateds, and so stabilize the products. The vapours are treated with an adsorbent substance to polymerize unsaturated constituents and to refine the furnace oil. The polymers formed are separated and the remaining vapours fractionated to obtain a furnace oil fraction which is separately distilled.

P. C. Keith, Jr. U.S.P. 2,143,949, 17.1.39. Appl. 7.7.36. Catalytic conversion of higher-boiling hydrocarbons into lower-boiling hydrocarbons by passing them at elevated temperatures through a finely-divided clay substance. W. S. E. C.

Gas, Diesel and Fuel Oils.

404. Influence of Excess Air and Feed Rate of Mazout on Furnace Efficiency. Y. Altchidjian. *Bull. Ass. franç. Tech. Petrol.*, 1939, **47**, 157–164.—The author has found that many installations burning mazout are operated with very high percentages of excess air; he has therefore investigated the effect of this on efficiency. Usually the air supply is controlled by dampers in the flue and at the air inlet. He gives curves of heat utilized in terms of excess air. Installations are often operated with 120–150% excess air, causing a heat loss of 10–15% above that occurring with normal regulation (50% excess air).

It was found that measurement of the depression at one point in the furnace was no guide to the quantity of excess air, but a relationship was established between pressure drop through the furnace and heat loss to the flue gases. It is considered that the only solution is the adoption of automatic control. K. A.

405. Aldrich Burner. Anon. *Air Condit. and Oil Heat* (U.S.A.), 1939, **12** (2), 38.—A description is given of a domestic burner for No. 5 oil by the Aldrich Co., Peoria, Illinois, which has a thermostatically controlled preheating vessel called a "Fuel

Changer." It is claimed to have novel features, such as absence of relief and cut-off valves. I. L.

406. Patent on Fuel Oil. F. Uhde. E.P. 499,372, 16.1.39. Appl. 15.7.37. Conversion of sluggishly-reacting diesel fuels—*e.g.*, hydrogenation oils poor in hydrogen—by treatment in the liquid phase at 150–350° C. and under increased pressure with oxygen or gases, liquids, or solids developing free oxygen. Very reactive bituminous substances obtained by slight hydrogenation of coal may be added either before or after this treatment. W. S. E. C.

Lubricants and Lubrication.

407. Chemistry of Lubricating Oils for Use in Aircraft Engines. C. M. Larson. *Oil Gas J.*, 9.2.39, **37** (39), 46.—The requirements for aircraft engines of different makes and service make it necessary to study chemical reaction of oils rather than physical characteristics alone. Military service and Pratt and Whitney engines are designed to use straight hydrocarbon oils, whereas Wright Aeronautical Corp. approved list is composed of compounded or chemical-additive oils. Proper inlet oil viscosity requirements of aircraft engines in secs. S.U. are: for normal take-off, 2800 or below; for emergency take-off 6000; desired operating state 500–110. Paratone and Acrylic ester provide means of increasing viscosity and V.I. of oils to which they are added, but the effect of addition agents for improving V.I. on service performance is little known. Solvent refining methods are used to improve the V.I. and stability to sludging of mineral oils, but wear, ring-sticking, varnish on pistons, and corrosion of bearing surfaces are also of the greatest importance. Oils of carbon residue content much below the viscosity (S.U. in secs.) at 210° F. ÷ by 100 give rise to oxidation products soluble in hot oil, leading to deposits on the hot surfaces of the piston, in ring-grooves, and on inlet valve-stems where there are low rates of oil-flow. Such oils also pick up iron salts which accelerate oxidation. Highly refined oils that form lacquers or varnish also deposit lead-salts, derived from the aircraft fuel, on important engine parts. Phosphites are being tried in the laboratory as anti-oxidants, but little is known of their use in the presence of lead at high temperatures. Used oil-sludge analysis is a poor index for ring-sticking, lacquer, etc., in service. A method of evaluating oils recommended by an aircraft-engine manufacturer on the basis of a 50-hr. endurance test is given.

The A.S.T.M. method of determining neutralization value does not give good repeatability, and results are not indicative of the corrosivenesss of oils in practice. Addition of oiliness agents sometimes give rise to bearing corrosion, especially where cadmium and certain lead-base bearings are used. Certain phosphite and sulphite additives have been used to check corrosion in lubricating oils, but their value at temperatures met in aircraft, especially in the presence of lead-salts, is unknown. The Underwood bearing corrosion-test machine, using appropriate bearing-metals and iron naphthenate addition, is useful in the study of corrosion resistance.

The use of oiliness addition agents is of definite value in reducing ring-scuffing on breaking-in of new engines, and there is a definite relationship between wear and oiliness. Certain ketones have proved very effective in reducing wear, but phosphates have fused with lead from the fuel, depositing salts in ring-grooves and on exhaust-valve stems. Flight tests for oiliness agents are essential, as dynamometer tests do not show up all chemical reactions met in flight. Increasing boundary lubrication under high pressures and temperatures in service necessitates further study of "oiliness" agents with various metals under varying conditions. R. A. E.

408. Spreading of Oil on Water. — Barillon and P. Woog. *Ann. Off. Combust. liq.*, 1938, **13**, 223–286.—An investigation was carried out to determine the spreading ability of various oils on water and indicate the characteristics necessary to prepare a very active synthetic oil. Spreading ability of various oils, particularly animal and vegetable oils, but also vaseline oil, turbine oils, etc., was determined, rates of advance of the oil films being measured under various conditions of p_H, dissolved salt, etc. Other experiments were carried out using the Langmuir method, compressing the extended film. Factors tending to increase extensibility of the oil

are tar-free acidity, unsaturation, low interfacial tension, and high molecular weight. In general, the hydrocarbon oils have very slight tendencies to spread on water.

J. L. T.

409. Patents on Lubricating Oil. N.V. de Bataafsche Petroleum Mij. E.P. 497,385, 19.12.38. Appl. 26.8.37. Preparation of lubricants for use at high pressures by adding to lubricants 1–10% (calculated on the weight of lubricants) of organic compounds containing at least two benzene rings to which at least two OH or COOH groups or at least one OH or one COOH group are connected direct, and which are either sulphur-free or contain sulphur in a non-reactive form.

Standard Oil Development Co. E.P. 497,782, 28.12.38. Appl. 17.7.37. Lubricant comprising a lubricating oil (viscosity 35–500° Saybolt at 210° F.), and a halogenated poly*iso*butylene polymer prepared at 0° to — 80° C. in the presence of boron trifluoride, aluminium chloride, or similar halide, the catalytic polymer having a mol. weight of 5000–6000.

Texaco Development Co. E.P. 497,789, 21.12.38. Appl. 21.5.38. Dewaxing of hydrocarbon oils using acetone benzol and incorporating in the mixture a wax crystal modifying substance—*e.g.*, crude montan wax and a polyvalent metal soap other than aluminium stearate, of an acid from the group consisting of higher acids or naphthenic acids.

A. C. G. Egerton. E.P. 497,973, 2.1.39. Appl. 2.7.37. Method of prevention of gum formation in oils caused by the action of nitrogen peroxide, which consists in adding an organic ferric compound—*e.g.*, ferric ricinoleate—in amounts of 0·05–5% by weight of the oil.

G. W. Johnson. E.P. 498,064, 3.1.39. Appl. 27.8.37. Production of oil-free wax by dewaxing hydrocarbon oils by means of propane and then treating the settled paraffin wax, which still contains oils, with a solvent in one or more stages at higher temperatures than those employed for dewaxing.

N.V. de Bataafsche Petroleum Mij., M. E. Spaght and C. H. Britten. E.P. 499,312, 19.1.39. Appl. 19.7.37. Process of extraction of phenolic compounds from mineral-oil distillates.

E. R. Lederer and G. M. Pfau. U.S.P. 2,142,359, 3.1.39. Appl. 8.4.33. Process of simultaneous dewaxing and acid-treating of mineral oil.

H. S. Noll. U.S.P. 2,142,525, 3.1.39. Appl. 17.2.37. Solvent refining of hydrocarbon oils using a mixture of cresylic and similar tar acids.

A. W. Francis. U.S.P. 2,142,939, 3.1.39. Appl. 27.6.36. Solvent refining of hydrocarbon oils using pyridine in which calcium nitrate is dissolved.

G. M. Fisher and M. E. Garrison. U.S.P. 2,143,190, 10.1.39. Appl. 15.10.35. Method of resolving emulsions containing solids—*e.g.*, mud, asphalt, and wax.

A. W. Hixon and R. Miller. U.S.P. 2,143,415, 10.1.39. Appl. 24.1.36. Solvent extraction of hydrocarbon oils using *ortho*-methoxybenzonitrile.

A. P. Anderson. U.S.P. 2,143,531, 10.1.39. Appl. 27.3.36. Solvent refining of oils with a selective solvent in two stages and contacting the second raffinate oil with a concentrated mineral acid in the presence of at least a portion of the first extract oil and separating the acid sludge formed from the sour oil.

F. R. Moser. U.S.P. 2,143,566, 10.1.39. Appl. 15.2.37. Production of synthetic lubricating oils by the catalytic polymerization of olefines using a phosphoric-acid catalyst.

H. O. Forrest and L. Van Horn. U.S.P. 2,143,872, 17.1.39. Appl. 31.12.36. Dewaxing and de-resinating lubricating oils.

P. C. Keith, Jr., R. E. Wilson, and M. J. Livingston. U.S.P. 2,143,882, 17.1.39. Appl. 15.8.35. Manufacture of bright stock by fractionating crude petroleum to

obtain a fraction free from light oils and having a viscosity greater than that of the desired bright stock and containing 1–4% of resins. This fraction is treated with propane, and finally with clay.

L. Liberthson. U.S.P. 2,143,890, 17.1.39. Appl. 2.10.34. Improved method of refining petroleum oils, especially of preparing white medicinal oil, by treating them with dichloroethyl ether and then with oleum. The acid sludge is separated, and the oil is treated again with dichloroethyl ether. The latter is removed from the oil, and it is then treated with a stripping solvent, *e.g.*, alcohol, acetone. The extract is separated from the oil, and air or nitrogen is passed through the oil to remove small amounts of stripping solvent or dichloroethyl ether, and the oil is then treated with alkali and filtered.

L. D. Fulton and J. M. Hinman. U.S.P. 2,144,652, 24.1.39. Appl. 9.3.37. Production of lubricating oil of high viscosity index by blending a solution of petrolatum, a dewaxed lubricating distillate, and naphtha at a temperature at which the wax constituents are soluble. The solution is chilled rapidly to precipitate the wax in fine crystals, and the naphtha is separated.

E. M. Dons, O. G. Mauro, and D. B. Mapes. U.S.P. 2,144,797, 24.1.39. Appl. 11.7.36. Solvent-extraction apparatus.

E. Terres, E. Saegebarth, and J. Moos. U.S.P. 2,145,185, 24.1.39. Appl. 22.3.35. Solvent extraction of hydrocarbon oil using a glyceryl ester of a higher homologue of acetic acid containing at least two carbon atoms in the alkyl radicle and an auxiliary solvent which is miscible with the oil and the main solvent in any proportion—*e.g.*, glyceryl ester of propionic acid.

A. P. Anderson and E. J. John. U.S.P. 2,145,784, 31.1.39. Appl. 4.3.36. Method of separation of hard wax of light colour from dark-coloured wax mixtures containing hydrocarbon liquid at ordinary temperatures.

L. A. Clarke and E. C. Knowles. U.S.P. 2,145,828, 31.1.39. Appl. 9.10.35. Production of light-coloured lubricating oil of low residual carbon content from petroleum residues by solvent extraction using a mixture of *ortho*-chlorophenol and phenol.

L. A. Clarke and E. C. Knowles. U.S.P. 2,145,829, 31.1.39. Appl. 9.10.35. Solvent refining of lubricating-oil fractions using a mixture comprising *ortho*- and *para*-chlorophenol in about equal proportions and chloracetic acid. The latter constitutes about 20% or more of the phenol mixture. W. S. E. C.

See also Abstract No. 431.

Asphalt and Bitumen.

410. Asphaltic Bitumen in Industry. J. S. Jackson. *J. Inst. Petrol.*, 1939, **25**, 51–67. A lecture with discussion on the uses of asphaltic bitumen with reference to pipe-lining and coating, joint filling compounds, protection and water-proofing in hydraulic works, and clay emulsions. G. R. N.

411. Some Properties in the Control of Road Materials. A. H. D. Markwick, A. R. Lee, and W. H. Glanville. *J. Soc. chem. Ind.*, 1939, **58**, 131–143.—The authors emphasize the necessity of controlling materials, mixing and laying within definite limits, in road construction. This paper is mainly concerned with the grading of aggregates and with the best procedure for surface-dressing. A careful study of the materials used is necessary for a satisfactory specification, in which only the essential requirements should be given to permit working to a reasonable time-table and price. The authors have accordingly studied the causes of aggregate variability, and found it to be of two kinds. The "apparent" variability may be due to variation in the size of sieve apertures, personal variation in sieving between different operators, or to errors of random sampling. "True" variability may be due to the type of rock, the methods used for crushing and screening, or to segregation, etc. For the lessening of apparent

variability the authors recommend reducing the tolerances of sieve sizes and number of sieves, use of mechanical sieving, and taking sufficiently large samples to offset the deviation by random sampling, the sample of required size being obtained by quartering. It is concluded that the main cause of true variability is the crushing and screening operation. The shape of the stone is largely determined by the crushing, and the principal factor controlling the grading of the product is considered to be the rate of feed through the screens.

For satisfactory results with surface-dressings, the quality, viscosity, temperature, and rate of spread of the binder, and the quality, size, shape, and rate of spread of the chippings must be adjusted to suit the condition of the road-surface and the traffic and climatic conditions. Since the best rate of application of binder varies with the size and shape of material, it is advantageous to use a cubical "single-sized material." The rate of spread of the binder is the most important factor, and should be neither too thin nor too thick, and controlled to within $\frac{1}{4}$ sq. yd./gallon. The best results are obtained only by machine spraying. A simple thermocouple method of determining the temperature of bituminous materials for mixing, laying, and rolling has also been developed. H. G. W.

412. Ministry of Transport. Experimental Work on Roads. Anon. *Report for 1937–38 of Experimental Work of Highways (Technical) Committee.*—The report gives details of, and results of observation on, various types of concrete, tar, and bitumen road-surfacings. It is stated, in connection with research undertaken by the Dept. of Scientific and Industrial Research in co-operation with the British Road Tar Association, that proposals are now under consideration for experiments on surface-dressing and thin carpets to determine the extent to which the road behaviour of tars can be predicted from the results of durability and other tests suitable for application in the laboratories. The experiments on the Colnbrook By-Pass, which were undertaken in an endeavour to obtain correlation between road behaviour and results of tests on the road machines at the Road Research Laboratory, will be more fully described in the *Report of the Road Research Board* for the year ended March 1938.

The tar and bituminous test-lengths laid on the Kingston By-Pass in 1930 are said, with one exception, to have continued to carry traffic satisfactorily without appreciable expense in maintenance or repairs. It is anticipated that this experiment will be terminated in 1939, during reconstruction of the By-Pass. Similar test-lengths laid on the Kirkham By-Pass in 1934 have not given such good results, and remedial treatment has been necessary on the single-coat asphalt and on one of the tarmacadam sections, whilst one of the cold-asphalt sections failed in 1936. The thin carpets laid in Worcestershire and Oxfordshire during 1934 are said to continue to give useful information. It is stated that when inspected in November the satisfactory results obtained in some instances were noted, but a lack of uniformity throughout a number of the sections was observed, indicating the necessity for greater care during manufacture or for the use of better plant in order to get a uniformly good result. The Committee are of the opinion that improvement is needed in the riding qualities of many roads in Great Britain. It is also stated that mechanical methods of placing, spreading, and consolidating tar and bituminous surfacings was included in the programme a year ago, and that the Committee are of the opinion that these questions merit special investigation. A. O.

413. Patent on Asphalt. P. L. Smith, V. L. Shipp, and A. H. Boenau. U.S.P. 2,144,694, 24.1.39. Appl. 7.5.35. Manufacture of asphalt of high ductility and low-temperature susceptibility by blending a solvent tar containing asphalt with a straight-run residue containing asphalt and a substantial amount of oil. The blended mixture is oxidized to form an asphalt of ductility not below 65 cm. at 77° F. and a temperature susceptibility not above 4 at 77° and 32° F. W. S. E. C.

See also Abstract Nos. 400, 401.

Special Products.

414. Synthetic Fatty Acids. B. Wolff. *Przeg. Chem.*, January, 1939, 45–51.—The paper deals with the production of synthetic fatty acids by oxidation of paraffin hydrocarbons. The process is particularly important for countries that have to import the greater part of their natural fats. Petroleum products, as well as higher paraffins produced in the Fischer–Tropsch process, can serve as starting materials. With regard to the chemical mechanism of the oxidation, it is stated that the process does not aim at an exact reproduction of the structure of natural fatty acids, only paraffinous monocarboxyl acids of an analogous specific gravity being obtained. Paraffins can be oxidized by air. The reaction is strongly exothermic, and has to be carefully controlled to prevent complete burning of the materials. As a result, mainly monocarboxyl acids are formed, besides high molecular alcohols, etc. It is not known whether the oxygen attacks the carbon chains of the starting-materials directly, or whether intermediate products are first formed. It has been found that addition of partly oxidized fractions to the paraffins accelerates the reaction. Also oxidation takes place the easier the longer the chain. Paraffins with over thirty-four carbons are therefore most suitable for the process.

Hydro-aromatic hydrocarbons are harder to oxidize than paraffins and naphthenes. Aromatic hydrocarbons are only oxidized when containing aliphatic side-chains.

As regards the physico-chemical conditions of the oxidation, excess air and good mixing are essential. One or more cubic metres of air per kg. paraffins ought to pass through the plant. Use of oxygen instead of air makes the process difficult to control. As the reaction is exothermic, heat must be supplied only during the initial stages, and after that cooling has to be applied to maintain the optimum temperature, which lies between 140° and 160° C. for paraffins and between 120° and 130° C. for naphthenes. The time of oxidation depends on the temperature and velocity of the air. Slow oxidation is easier to control, but more undesirable products are formed. Quick oxidation may surpass the optimum conditions and destroy the starting-material.

Small additions of sodium hydroxide accelerate the oxidation, which is probably due to the emulsifying action of the minimal amounts of soap formed. The process can be conducted with or without catalysts. Metallic salts of organic acids have been shown to be particularly good catalysts. E. J. W.

415. Manufacture of Blacks of the Carbon Black Type from Materials other than Natural Gas. G. Bruni and T. G. Levi. *Proc. Rubber Tech. Conf. London*, May, 1938. Paper No. 29, pp. 467–469.—A short review is given of the attempts to manufacture blacks of the carbon-black type from coal, vapours of benzene, naphthalene, anthracene, phenanthrene, and carbazol, and from town gas, coke-oven gas, and water gas, and mixtures of the above solid and gaseous materials. Yields of 25% of black have been obtained in Germany from acetylene, and its properties are similar to those of natural-gas carbon black, although the cost is higher. The rubber stock is less plastic and the vulcanized material more rigid, but particularly high resistance to abrasion and cutting are afforded by its incorporation into mixes. C. L. G.

416. Use of Synthetic Rubber (Buna) as an Insulation for Submarine Cables. E. Badum. *Proc. Rubber Tech. Conf. London*, May, 1938. Paper No. 40, pp. 463–465.—A review is given of the various materials developed as insulating materials for submarine cables. A mixture of balata and gutta-percha with rubber freed from proteins (which affect the water absorption) and with waxy materials or fully deresinated gutta-percha containing softeners is satisfactory, but expensive. The Buna synthetic rubber is a satisfactory substitute for the purified rubber, giving, when mixed with gutta-percha or balata, the required electrical and water-resistance properties. Practical tests over a period of years in submarine cables indicate that the electrical properties are maintained. C. L. G.

417. Incorporation of Polymeric Resins into Natural Rubber. R. G. R. Bacon, E. H. Farmer and P. Schidrowitz. *Proc. Rubber Tech. Conf. London*, May, 1938. Paper No. 57, pp. 525–534.—Experiments on the incorporation into natural rubber of polymeric resins of the polystyrene and polyacrylic esters and nitriles are described. The methods

of incorporation and the effect on the properties of the rubber are discussed. The resin is mixed with a polymerization catalyst and emulsified with water, this being heated until polymerization is complete, the latex so produced being blended with a normal or concentrated rubber latex. Relatively small percentages of the resins modify the physical properties of the rubber, some—*e.g.*, the polymethacrylic methyl ester—improving them slightly. C. L. G.

418. Vulcanizing Characteristics of "Neoprene." M. Jones. *Proc. Rubber Tech. Conf. London*, May, 1938. Paper No. 78, pp. 411–421.—A study is made of the behaviour of Neoprene E under vulcanizing conditions compared with that of natural rubber, and of the effect of various vulcanization accelerators. Neoprene can be directly vulcanized by heat, but the product lacks tensile strength. Best results are obtained by the addition to 100 parts of Neoprene of 10 parts light calcined magnesia, 5 parts zinc oxide, 5 parts wood rosin, vulcanization being effected for 30–60 min. at 141° C. A study of the effect on recovery after compression on rubber and Neoprene heated for various periods at 100° C. indicates that rubber changes little until after 20 min. heating, when set-up increases rapidly, whereas Neoprene sets up gradually and progressively. This avoids distortion of Neoprene during vulcanization, but requires the presence of sufficient softener (normally a combination of mineral oils, factice, and chlorinated naphthalenes) to ensure a rapid flow before a marked set-up occurs. The optimum vulcanization period for Neoprene has been determined from a consideration of the variation in stress and strain properties, the tensile strength, the swelling in benzine, and the modulus at 600% elongation, it being shown a good tensile strength is soon attained, but that about 45 min. is necessary to obtain the remainder of the properties. The addition of up to 3% sulphur almost completely eliminates the tendency to harden on storage, whilst 0·25% of catechol reduces the vulcanization period very considerably, in addition to improving tensile strength, permanent set, modulus, and resilience. C. L. G.

419. Some Oil-ageing Properties of Synthetic Rubber-like Materials. T. L. Garner and J. Westhead. *Proc. Rubber Tech. Conf. London*, May, 1938. Paper No. 81, pp. 423–433.—The effect of immersion in lubricating oil and heating at 70° C. on the weight, hardness, and tensile properties of mixtures containing Perbunan and Neoprene synthetic rubber materials and of the alkylene polysulphide condensation product—Thiokol—is discussed.

The physical properties of Thiokol are relatively little affected by heat or oil-ageing, although oil extracts some of the sulphur compounds. However, its maximum physical properties are poor compared with those of other synthetic materials. Neoprene swells during immersion in oil, becoming softer, but hardens later, whilst the tensile strength falls slightly. It hardens considerably on heating, this being emphasized by under-vulcanizing, but is not improved by over-vulcanizing or by the addition of an anti-oxidant. At room temperatures surface-hardening takes place, but disappears on heating to *e.g.* 70° C. Perbunan shrinks slightly in oil, probably due to the presence of a soluble elasticator or plasticizer, after which there is a gain in weight and hardness, the tensile strength increasing to a maximum, whilst the elongation is steadily reduced. Over-ageing at 70° C. increases the hardness to a lesser extent than oil-ageing, but at ordinary temperatures little hardening results. Perbunan also differs from Neoprene in developing the maximum physical properties only after compounding, whereas Neoprene is not appreciably altered in tensile strength on loading. C. L. G.

420. Development of Swelling Resistant Rubber-like Materials in Germany. P. Stöcklin. *Proc. Rubber Tech. Conf. London*, May, 1938. Paper No. 86, pp. 434–447.—The development in Germany, manufacture, vulcanization, properties, and applications of oil-resisting products which can be converted by vulcanization or an analagous process from a plastic to an elastic condition are discussed. Three types of products are dealt with: (1) Butadiene polymerization products, including Perbunan (formerly Buna N), which is a butadiene-acrylic acid nitrile mixed polymerizate, and perbunan extra (formerly Buna NN) which is similar, but with a higher acrylic acid nitrile content. (2) Thioplasts, including Perduren G, prepared from dichlorethyl ether and sodium polysulphide; Perduren H prepared from di(chlorethyl)formaldehyde acetal

and sodium polysulphide, and Perduren SP, an aqueous suspension of Perduren H. (3) combinations of types (1) and (2)—*e.g.*, Perduren L, a special combination of Perbunan and Perduren. C. L. G.

421. Rubber Plastics. H. Barron. *Proc. Rubber Tech. Conf. London*, May, 1938. Paper No. 99, pp. 1110–1115.—A discussion is presented of methods developed to improve the stability of rubber by substituting vulcanization by chemical treatment, resulting in the formation of plastic materials. The products discussed include: (1) rubber containing cobalt linoleate, milled or blown with air, which is suitable for paints or insulating finishes after baking; (2) chlorinated rubbers which produce chemically resistant paints and varnishes; (3) transparent rubber plastics suitable as moisture-proof paper produced by the action of HCl on rubber. A modification includes the addition of halogenated benzene to the mixture, the rubber hydrochloride being precipitated with alcohol; (4) rubber isomeric plastics formed by the action on rubber of sulphuric or sulphonic acids, metallic chlorides, boron fluoride, and fluoboric acid, etc.; (5) plastics from rubber by treatment with phenol and with formaldehyde have been unsatisfactory, but the most promising avenue is the addition of resinous plastic media. C. L. G.

422. Plastics having Rubber-like Properties. G. von Rosenberg. *Proc. Rubber Tech. Conf. London*, May, 1938. Paper No. 102, pp. 450–462.—A review is presented of the properties, processing characteristics, and applications of thermoplastics of three types: (1) having the properties of soft rubber without the addition of plasticizers; (2) hard but becoming rubber-like by incorporation of plasticizers; and (3) latex-like emulsions of synthetic polymerization products to be used partly with and partly without plasticizers. Group (1) includes (*a*) the polymerized acrylic-acid esters—*e.g.*, Acronal and Plexigum, which are expensive and yield films of low rebound elasticity, but have a "handle" similar to that of soft rubber, the relative hardness of the films decreasing in the sequence methyl ester, ethyl ester, butyl esters; (*b*) highly polymerized saturated hydrocarbons—*e.g.*, Oppanol B and Vistanex, which very closely resemble rubber in constitution and behaviour. With increasing molecular weight the mechanical properties are increased, but the workability decreases, whilst the chemical and electrical properties are only slightly dependent; (*c*) alkyl condensation products, which are used for electrical insulation, but have otherwise only limited applications. Group (2) includes (*a*) polymerized vinylchloride and its interpolymerizates—*e.g.*, Koroseal, Flamenol, Vinylites, Igelites, and Mipolam—which when prepared with plasticizers—*e.g.*, tricresyl phosphate, phthalic acid esters, etc.—give soft rubber-like products; and polyvinyl alcohol—*e.g.*, Polyviol and Povimal—which, when treated with water or strongly hydrophilic plasticizers like glycerine, yield similar products; (*b*) cellulose derivatives of which the esters are of little importance to the rubber industry, whilst the ethers may be plasticized to yield products of soft rubber consistency. C. L. G.

423. Patent on Special Products. G. W. Johnson. E.P. 498,242, 5.1.39. Appl. 26.7.37. Manufacture of butadiene by treating vinylacetylene with amalgams of alkali metals in the presence of substances which develop hydrogen with these amalgams. W. S. E. C.

See also Abstract No. 398.

Detonation and Engines.

424. Development of the Mono-Sleeve Valve for Aero-Engines. A. H. R. Fedden. *J. Instn auto. Engrs*, 1939, **7** (5), 64–100.—The first double-sleeve valve engine was produced in 1905, but an important step forward was made in 1909, when Burt and McCollum independently discovered that the same result could be obtained with a single sleeve by combining a translatory and rotary motion. Not only is the design simpler, but the twisting motion assists lubrication. The paper reviews the subsequent historical development of the single-sleeve principle, which was taken up by the Bristol Aeroplane Company in 1926. Their development work on single air-cooled cylinders

is described in some detail; the b.m.e.p. has been raised from 120 lb. per sq. in. in 1932 to 220 lb. per sq. in. in 1938, and minimum fuel consumption is now less than 0·4 lb./B.H.P./hr. Comprehensive data are given to show that the performance of sleeve-valve engines compares favourably with the most modern poppet-valve types, whilst servicing is simplified. Among important advantages of the sleeve-valve engine are: elimination of hot-spots, higher compression pressures, improved volumetric efficiency, freedom from lead corrosion, and better control of turbulence. The paper includes brief illustrated descriptions of Bristol sleeve-valve engines now in production.

K. A.

425. Notes on Aero-Engine Research. P. H. Rayner. *J. R. aero. Soc.*, 1939, **43**, (337), 19–32.—The paper deals with some forms of experimental equipment suitable for use in aero-engine research, and particularly with various types of electronic (cathode-ray) indicators. In adapting this instrument to aircraft engines the greatest difficulty has been to produce a satisfactory pressure unit. Six classes of unit have been used or proposed: electromagnetic, resistance, capacitance, piezo-electric, high-frequency, and photo-electric. Various types are described and illustrated, and means of operating the time-sweep unit are outlined. The electronic indicator has provided new means of studying detonation; this phenomenon is characterized by a very sharp pressure rise towards the end of combustion, and the resultant pressure waves in the cylinder obey the laws of sound. Frequencies of 3500–7000 are observed in practice. The R.A.E. detonation meter employs a piezo-electric pressure element and an amplifier which filters off the frequencies below about 2000 cycles per sec. The filtered output is fed to a trigger circuit, and detonation intensity is measured on an arbitrary scale by the grid bias, which is adjusted until the peak signal just triggers the valve. The Midgley bouncing-pin gives a rating corresponding to a maximum frequency response of 400 c.p.s., which may account for some discrepancies in knock ratings between laboratory and full-scale aero-engines. K. A.

426. Recent European Developments in High-Speed Diesel Engines. P. M. Heldt. *J. Soc. aut. Engrs.*, 1939, **44**, (2), 77–84.—Automotive-type diesel engines are used much more extensively in Europe than in the U.S.A. Due to the greater cost differential between carburettor and diesel fuels in Europe, the diesel is justified in buses and trucks of more than 2 or 2½ tons capacity. There is a considerable market for railcars, and the moderate-sized diesel is rapidly becoming popular for marine applications, particularly in England. Of 176 European engines, 55 have direct injection; 53 have precombustion chambers; 49 have turbulence chambers and 19 are air-chamber type. The two-stroke cycle is receiving considerable attention, especially in the aircraft field. In the Clerget diesel aircraft engine, now under development, double-injection pumps are used. One injects a small quantity of high-cetane fuel to reduce ignition lag; the other is supplied with a fuel containing alcohol, the high latent heat of which keeps down maximum pressure. The paper includes illustrated descriptions of typical European engines, including the standardized German Army truck engine.

K. A.

427. Duration of Combustion in a Commercial Diesel Engine. A. F. Robertson, R. A. Rose, and G. C. Wilson. *J. Soc. aut. Engrs*, 1939, **44**, 117–124.—This article describes a series of tests using three engines. The photo-electric combustion indicator developed by the University of Wisconsin, which has been fully described in previous articles, was improved in detail for the present tests, and a new top dead centre indicator capable of indicating top centre within ¼° of engine-crank travel was also used.

The bulk of the tests described were made with a single-cylinder Fairbanks-Morse four-cylinder engine of 4¼ bore × 6 in. stroke, the compression ratio being 14·5 : 1, injection pressure 1400 lb/sq. in., speed, 1425 r.p.m., and water-jacket temperature 150° F. The engine has a high turbulence head, with swirl-chamber which is fitted with two quartz windows. The data obtained on twenty-seven fuels with this engine include the comparison of length and timing of combustion with varying injection timing, the effect of injection timing on lag, and variation in combustion period with varying lag and load.

From dynamometer tests on two engines (a single-cylinder, open-chamber engine

and a six-cylinder engine similar to the swirl-chamber single-cylinder) fuel ratios were determined on six fuels, varying in cetane number from 25 to 87.

It is found that high-cetane diesel fuels not only start to burn earlier in the cycle, but continue to burn longer during the expansion stroke than does a fuel of low cetane number. A comparison of data from the open-chamber engine and the swirl-chamber engine shows that the higher turbulence of the latter has no direct bearing on ignition lag, although the greater turbulence causes slight changes in the shape of the ignition-lag curves. C. H. S.

428. Design and Construction of Alternators for Coupling to Diesel Engines. F. Fitchett and W. R. Holland. *Diesel Eng. Us. Ass.*, Pubn. No. S.150.—In the first main section of this paper, by the use of analyses of the torsional systems of several types of diesel-alternator sets as examples, the authors discuss the effect of the number of engine-cylinders and speed, alternator coupling-shaft and bearing arrangement on torsional critical speeds and alternator shaft stresses. The effect of forced vibrations on the cyclic irregularities of the alternator rotor is also shown.

It appears, from the analyses, that the dangerous critical speeds can generally be arranged to be above the normal running speed by adopting the arrangement of a single bearing alternator and a short, stiff shaft coupling the rotor to the engine. In certain cases, however, particularly with diesel-alternator sets with as many as eight engine-cylinders and operating at high speeds, it is preferable to arrange the shaft-connection between fly-wheel and rotor very elastic by means of a flexible coupling. Dangerous critical speeds are then run through quickly, and, if the type of coupling is chosen so that the flexibility varies when the torque varies, the coupling will introduce into the system damping characteristics which will greatly reduce the vibration stresses when running on the critical speeds.

The second main section of the paper deals chiefly with electrical considerations to be made in the arrangement of diesel-alternator systems. Following a discussion of the effects produced by cyclic irregularity, the authors emphasize the importance of this factor as affecting alternator voltage. It is pointed out that a change in speed of 1% would produce a change in alternator voltage of about 1·7% and a light variation of about 7%. Further factors which must be considered when engine-alternator sets are run in parallel are next dealt with, and recommendations are given to secure the most satisfactory operation.

The paper concludes with notes on other features in the mechanical design of alternators and on the erection of the machine on site. E. F. C.

429. Symposium on the Starting of Diesel Engines. Anon. *Diesel Eng. Us. Ass.*, Pubn. No. S.148.—This symposium, which comprises contributions from most of the principal diesel-engine builders in this country, and from many well-known Continental makers, covers the subject of starting diesel engines from almost every angle.

Contributors representing makers of the larger engines describe chiefly the actual starting mechanism they employ, in which compressed air is invariably the operating medium.

The majority of the builders of the smaller classes of diesel engines adopt different means of starting, according to the service and size of the engine. The smallest sizes are generally started by hand or by a battery-operated electric motor and Bendix pinion, and the intermediate sizes also by the latter method, or by conventional compressed-air mechanism embodying some form of timed admission valve.

Among alternative methods of starting described by other contributors representing the medium-size manufacturer are by means of an auxiliary engine and clutch, or by an impulse starter which is operated by the pressure generated when a small amount of explosive compound is fired electrically.

The remaining contributors to the paper describe the technique they recommend should be adopted to facilitate starting. Among the chief factors considered are priming of the fuel-injection system, the provision of warm inlet water to the jackets, and the use of a low-viscosity lubricating oil and high-cetane-value fuel. An increase of injector-release pressure within the limits imposed by roughness of running has in some cases been found to facilitate starting while the introduction of fuel or lubricating oil into the intake ports—which serves the dual purpose of sealing piston-rings and

valves, besides raising the compression ratio—has been found to have a similar beneficial effect.

The discussion on the symposium is appended. E. F. C.

430. Injection Equipment for Compression-Ignition Engines. H. G. Dunn. *J. Instn auto. Engrs*, 1938, **7** (1), 32–48.—The design, production, and testing of fuel-injection equipment is dealt with generally in this article.

As regards the pumping element, the relation is shown between the various phases of operation; and requirements of the pump to suit different types of engine are discussed. Cam contours are briefly discussed, and an analysis of a typical injection pump cam is shown. Other features of design are dealt with, including the delivery valve; the effect of the length of fuel-pipe and injection pressure on pump discharge; the governor; and the injection-nozzle.

Poor idling is attributed to too large fuel capacity between the pump and nozzle, and to bad design in the centrifugal governor, which sometimes fails to respond to small speed fluctuations when idling, due to the fact that insufficient power is available to overcome the resistance offered by the inertia and friction of the pump-control mechanism.

It is now becoming general practice to adopt higher differential ratios between valve-guides and seat diameters, in the injection-nozzle of the multi-hole types commonly used in open-chamber engines, to overcome the tendency of carbon to penetrate into the spray-holes, the improvement in this direction probably being achieved by the fact that the drop in injection pressure is much less with the high-ratio design. The type of construction in which the needle-valve guide is isolated as far as possible from the combustion-chamber is becoming increasingly popular for the direct-injection engine. The absence of a standard method of test for fuel-injection systems is deplored, and the author enumerates some of the variables which affect the pump delivery.

C. H. S.

431. Recent Developments in Piston-Ring Materials. B. A. Yates. *J. Soc. aut. Engrs*, 1939, **44**, 49–58.—Whereas much attention has been paid to piston-ring design-factors such as proportions, loadings, circularity, etc., the question of material has been relegated to the background. The causes of cylinder and ring wear are abrasion, corrosion, and erosion. Abrasion is best eliminated by provision of adequate oil- and air-filters and crankcase ventilator-screens. The best antidote to corrosion is rapid warming-up and proper crankcase ventilation. The present article deals mainly with erosion, which is attributed to metal-to-metal contact upon failure of the lubricating-oil film. Scuffing is due to too-rapid erosion, and is a problem of proper maintenance of the oil film, rather than of oiliness characteristics.

The microstructure of piston-ring materials is discussed, and it is stated that a pearlitic structure without free ferrite is highly desirable. Ring wear is considerably reduced by raising the phosphorus content to 0·75%. The ability to resist scuffing is most important during the run-in period, and various types of surface-coating material are available to help to decrease the severity of scuffing. Engine tests have demonstrated that superficial coatings reduce ring wear from scuffing and erosion, and that a very thin coating of tin is more effective than other types of metallic or non-metallic coatings. Probably the soft tin coating has the ability to re-distribute the surface material under pressure, but its good performance may be due to the ease with which it can be wetted, thus retarding rupture of the oil-film. K. A.

432. Multi-cylinder Engine Detonation and Mixture Distribution. A. J. Blackwood, C. B. Kass, and O. G. Lewis. *J. Soc. aut. Engrs*, 1939, **44**, 125–134.—This article describes tests made on an eight-cylinder in-line engine with overhead valves to investigate the knocking tendency of each cylinder, as affected by the unequal spark timing to individual cylinders which is found to be prevalent with the normal production ignition equipment.

From analysis of the exhaust gases of individual cylinders data were obtained on the air-fuel ratio of the mixture supplied to each cylinder, and the effect of varying volatility was investigated.

In order to determine the spark-timing required on each cylinder to produce a

given degree of knock, two ignition systems were used in parallel, and so arranged that the spark advance to one or more cylinders could be advanced or retarded without affecting the remainder.

Details are given of the mixture strength spread between cylinders over the whole engine-speed range on regular gasoline, and it is shown that in this particular case one cylinder gets progressively richer and another progressively leaner; the spread in air-fuel ratio between the richest and leanest varying from 8·5 : 1 to 18·5 : 1 at 400 r.p.m., and from 11 : 1 to 16 : 1 at 2200 r.p.m.

Data on fuels of varying volatility were obtained at 1000 r.p.m., and full throttle and showed air/fuel ratios varying between cylinders from 7 ratios on regular grade gasoline to 0·9 ratio on butane.

It is shown that octane-number requirements of individual cylinders may vary by 10 points, due to uneven spark timing; and that with perfectly synchronized spark timing unequal distribution may cause the octane-number requirements of individual cylinders to vary by 15 octane numbers.

Tests with a specially designed unheated manifold, using two carburettors showed a maximum variation in air-fuel ratios between cylinders on regular grade gasoline of 3·1 ratios as against 5·8 ratios for the unheated and 7·1 ratios for the heated standard manifold, respectively, at 1000 r.p.m. and full load.

The authors point out that the engine tested is typical of modern car engines, and conclude that substantial reduction in average anti-knock requirements of cars might be effected without making any major changes in engine size, speed, or compression ratio. Care in assembling cars at the factory could bring about an average decrease in octane-number requirements of several points, which decrease could be utilized in turn in future designs to permit of increased compression ratio and efficiency. C. H. S.

433. The Modern Portable Gas Producer. B. Goldman and N. C. Jones. *Petrol. World* (Lond.), 1939, **36** (460), 3–5.—Four types of gas producer are distinguished: (*a*) the up-draught in which fuel and air move in opposite directions, (*b*) the down-draught, (*c*) the cross-draught, and (*d*) the double-zone double draught; (*a*) generally provides the best gas, whilst (*b*) can be used with advantage for dirty or tarry fuels; (*c*) is the simplest to construct, and relies on a very high temperature, and (*d*) combines the production of good-quality gas with the ability to use low-grade fuels. Considerable difficulty is experienced in ensuring a regular supply of suitable fuel, but the availability of low-temperature coke has gone far towards solving this problem. The use of solid fuel, the cheapest indigenous source, for gas producers is limited to applications where the extra weight of the gas-plant does not unduly affect efficiency, since it is necessary to make use of existing resources in the shape of vehicles already on the road and of manufacturing facilities of standard types.

Gas-producer equipment attached to standard vehicles may be fitted on the side opposite to the engine induction or on the running-board, or partly in and partly behind the driving-cab. In buses and private cars it is usually fitted at the extreme rear.

Tests with a Bedford 30-cwt. truck equipped with a Koela gas-producer showed that the operation was only slightly inferior to that with gasoline on hill climbing and about the same with respect to acceleration. It is noted that while there are very few gas-producer vehicles in Great Britain, there are several thousand in daily use in Continental countries using wood, peat, lignite, and coke. G. R. N.

434. Tank Mileage. W. E. Zierer and J. B. Macauley, Jr. *J. Soc. aut. Engrs.*, 1939, **44**, 29–34.—The term "tank mileage" refers to the average miles per gallon obtained under normal driving conditions, as distinct from "mean road-load economy," which is the miles per gallon obtained on constant-speed test runs in opposite directions on level road at 10 m.p.h. speed intervals from 20 to 60 m.p.h.

The effects of air resistance, chassis friction, gear ratio, and car weight on constant-speed road economy are shown, and a comparison is made between calculated values and actual test results.

Many other factors over which the designer has no control, but which affect economy, are discussed. It is shown that a car starting at 20° F. requires to be driven for 11

miles at an average speed of 25 m.p.h. before the fuel economy reaches its normal level, although water temperature and manifold temperatures become constant after 3 miles driving. Tests on forty-five cars of the same model showed spread in economy figures from 13·7 to 23·4 miles per gallon. These figures were obtained from a month's normal driving of each car, and illustrate the variations obtained with different drivers and conditions of operation. C. H. S.

Economics and Statistics.

435. Economic Equilibrium in Petroleum-Refining Operations. N. D. FitzGerald. *Petrol. Tech.*, Feb., 1939, A.I.M.M.E. Tech. Pub. No. 1030, 1–15.—Economic equilibrium in petroleum-refining is a dual concept. It embraces both the overall balance between total storage and total demand for major products, and the internal balance between the demands and inventories of the various products. The latter is the more complex. The general uptrend in the total demand for petroleum products during the past decade has been marked by considerable differentiation between the several products. In the long-run the supplies of the various products are adjusted by the relationship between economic utilization and basic cost.

There is a persistent lag of from three to six months in the conformity of the total demand for petroleum products with industrial production, and a persistent lag of from twelve to fifteen months in the conformity of inventories of petroleum products with industrial production. It appears that inventories of petroleum products of any particular month reflect the influences of total demand of the twelfth preceding month, the level of industrial production of the twelfth preceding month, and the current volume of crude oil in storage. The rate of supply of each product reflects the influences of demand, price, and inventory.

Inventories of each product exert a positive influence upon the rate of supply instead of exerting a negative or normalizing tendency. Therefore, price is required to fulfil not only its conventional economic functions but also that of overcoming the tendency of inventories to induce additional supplies. The joint nature of the supply of petroleum products causes any abnormalities in the supply-inducing factors to be transmitted from one product to another, rather than to be counteracted. Recent shifts in the importance of the supply-inducing factors have been favourable in character.

The economic problems of the oil industry have grown rapidly in recent years and now appear of similar magnitude to the engineering problems that characterized an earlier phase of its growth. G. D. H.

436. The Year 1938 in Petroleum Statistics. Anon. *Przem. Naft.*, 10.2.39, **3**, 80–82.—The increase in production, having reached its culminating point in 1937, had ceased in 1938. Figures are by no means alarming, however, the index for 1938 being 150·8 as compared with 156·2 for 1937 (1932 = 100). This decrease was mostly restricted to the U.S.A., where it amounted to 5·2%, whereas it was only 0·6% in other countries.

Russia showed an increase in production of 3·2%. Canadian production raised its level by almost 1½ times. A table is given showing the production of the oil-producing countries in 1937 and 1938, and giving the respective percentage changes.

The prices of petroleum products decreased considerably in 1938. A table shows the notation of different petroleum products on the world markets. E. J. W.

437. Petrol Consumption in Motor-Cars. Anon. *Przem. Naft.*, 10.2.39, **3**, 82.—Tables are given showing the petrol consumption, the number of motor-cars, and the consumption of petrol per motor-car in a number of countries in 1937. France shows the lowest consumption of petrol per motor-car, with 1200 kg. per annum. Great Britain takes the third place, with 2100 kg. per annum. E. J. W.

History of Petroleum.

438. Iranian Petroleum in Ancient and Medieval Times. L. Lockhart. *J. Inst. Petrol.*, 1939, **25**, 1–18.—An historical account of the occurrence and use of petroleum and bitumen in Iran, with numerous quotations from original writings. G. R. N.

439. Petroleum and Bitumen in Antiquity. R. J. Forbes. *J. Inst. Petrol.*, 1939, **25**. 19–23.—A summary of a lecture delivered to the Society for the Study of Alchemy and Early Chemistry on the early history of the petroleum industry. G. R. N.

BOOK REVIEWS.

Les Gisements de Petrole. By G. Macovei. Preface by M. Charles Jacob. Pp. vii + 502. Figs. 222. Masson & Cie, 120, Boulevard Saint Germain, Paris, 1938. Price 120 fr.

Translation of a Review in French by D. Schneegans.

Professor Macovei's book is the result of many years' study at the École Polytechnique in Bucharest. The author has acquired considerable information, which he has been able to condense into a volume, which is at the same time concise, clear, well illustrated, and full of facts. The recent Petroleum and Geological Congresses have given the author an up-to-date outlook on the varied questions which are encountered in the study of oil-bearing strata. The work is divided into two parts; the first is devoted to the genesis and nature of the strata, the second, in more detail, to the geographical distribution and descriptions of the principal oil-bearing strata of the world.

The chapters devoted to the origin of petroleum give an account of present knowledge of the geological conditions under which petroleum must have been formed, but also show how far we still are from an entirely satisfactory solution to this problem. It appears that the author is a resolute believer in the hypothesis of the organic origin of petroleum; and it is no doubt with reluctance that he also gives impartially the hypothesis of the mineral origin of bitumen, without, however, clearly explaining the part between the actual magmatic origin and the bitumens displaced from the sedimentary petroliferous beds by volcanic phenomena such as the heating of the ground or the formation of chimneys—open paths to migration. The phenomena of the migration of oil are studied with particular care and with the aid of very convincing examples. The Roumanian strata, which are well known to the author, are, from this point of view, an incomparable source of knowledge. It is probable, however, that such an intimate knowledge of the oil-bearing strata of the calcareous type which are becoming of increasing geological and economic interest should have provided the author with valuable arguments in favour of lateral migration to a great distance. Recent accounts by American geologists concerning the influence of regional pyrogenic movements on the displacement of petroleum in the sub-soil open up a wide field of study, the results of which may be of considerable practical importance. The facts known about paleogeography, paleogeology, regional tectonics, the rational interpretation of oil-shows and of wildcats enable one to reconstitute the large arteries travelling by lateral migration and to recognize on their path exploitable accumulations entrapped in certain local structures.

The porosity and permeability value of the storage rocks and the conditions of imperviousness of the argillaceous roofs of the petroliferous series are studied by the aid of well-chosen examples, a large number of which refer to Roumania. The principal types of structure are reviewed in brief. The descriptions of the strata contained in the second part supplement these data. The production engineer will also find some information concerning the conditions of exploitation of the oil-bearing strata.

Modern methods of production, of gas utilization, of well-spacing, and of draining the remaining petroleum are based on a knowledge of the characteristics of the strata, such as the structural and working conditions, and the characteristics of the source rock. These pages clearly show that the rôle of the field geologist is not merely that of an archevist, but that it is chiefly to supply the production engineer with all he needs to enable him to direct production in a rational way.

Prospecting and exploration of new oil-bearing strata conclude this first part. The principles of the methods of geological and geophysical prospecting and exploration by drilling are set out in a practical way. Nevertheless, details are lacking concerning the connection between the oil-shows and the exploitable

accumulations, on the value of these shows and their interpretation in the course of prospecting.

In the second part M. Macovei conveys a very comprehensive picture of the world's oil-bearing strata, arranged in the order of the regional geology of each country. In this description information is given concerning the stratigraphic character, the structural conditions, the productivity, and the properties of the crude of the principal exploited strata.

We are indebted to M. Macovei for the amount of work which he has had in collecting and collating the knowledge scattered in numerous publications and languages. The soundness of the information, the numerous examples, the clarity of the explanations, and the alphabetical index which concludes the volume make Prof. Macovei's work a treatise which should have a place in the library of all petroleum technologists.

D. SCHNEEGANS.

Fundamentals of the Petroleum Industry. By D. Hager. Pp. xvii + 445. MacGraw-Hill Publishing Co., Ltd., London. 1939. Price 21*s.* net.

Mr. Dorsey Hager has, as he states in his preface, produced a book that presents a comprehensive *outline* of the petroleum industry and its problems. It covers all aspects of the industry from the historical, through drilling and production, refining to marketing, with additions such as oil securities and legislation, but it is to be regretted that every aspect has been so condensed as to make the information supplied of only nominal value to anyone desirous of obtaining more than a very general knowledge of the subject.

Much that has been included does not come under the heading of fundamentals. It is easy to understand that an industry such as the Petroleum Industry would be a magnet of "greenhorns" and "hangers-on," but these are not fundamentals. They exist solely as a result of the prosperity that has accrued from the efficient manner in which the industry has been operated.

Too little space has been allotted to the major branches and far too much to legislation, etc., and much of the subject-matter reads like supply companies' catalogues, with no more than a brief description of the piece of equipment.

Many operations of vital importance are given scant treatment. Geophysical methods are disposed of in five pages, of which at least two and a half pages are occupied by diagrams. Polymerization receives only a little more than one page, whilst solvent-refining is given no more than fifteen lines. Rotary drilling receives less space than standard cable tools, which, to say the least, is condensation carried to extreme. These examples are typical of the whole book, and it is to be regretted that the author has attempted to cover so much ground that there is little of sufficient detail to be of value for reference purposes.

The academic value of the work has been reduced still further, as not a single reference is given to enable a reader to obtain more detailed information on any particular subject.

It is difficult to condemn the thought that prompted the author to embark on this book, but similarly it is difficult to recommend it to other than those with little or no technical knowledge of the industry.

If the author's intention is to supply the needs of the non-technical members of the staffs of the Petroleum Companies, as well as the lay public, he has produced an admirable treatise, and one that should do much to increase interest in an industry which has received far too little advertisement outside the large producing countries.

The production and layout of the book are good, but it does not contain the material necessary to invoke the remark that it is a book that should be on the book-shelf of every petroleum executive and student of the Petroleum Industry.

L. V. W. CLARK.

BOOKS AND PUBLICATIONS RECEIVED.

The Mechanical Testing of Bituminous Road Materials. A Survey of the Literature. By T. Lonsdale. Department of Scientific and Industrial Research, Road Research and Experiment, Special Report No. 1. Pp. 47. H.M. Stationery Office. Price 1*s*.

As a necessary preliminary to the study of the physcial and mechanical properties of bituminous surfacings a critical examination was made at the Road Research Laboratory of existing literature. This critical survey forms the present report.

British Association for the Advancement of Science. Report of the Annual Meeting, 1938. Pp. lvii + 568. Appendix 1–252. The British Association, Burlington House, London, W.1.

The 1938 Annual Meeting of the British Association was held in Cambridge, August 17–24. This report contains the Presidential Address, the Sectional Presidents' Addresses, and a scientific survey of Cambridge and district.

The Junior Institution of Engineers. Journal and Record of Transactions, Vol. XLVIII, 1938. Pp. 590. Percival Marshall & Co., Ltd., 13–16, Fisher Street, Kingsway, W.C.1.

Included in the papers read before the Institution are the following: "Compression-Ignition Engine Development," by H. G. Pusey; "Light Alloys and their Use in Engineering," by A. C. Jack; "Mechanical Testing of Engineering Materials," by J. Trickett; "Notes on Constructional Details of Centrifugal Pumps," by J. Cranston; and "Water Turbines," by W. J. Kennelly.

Improving the Properties of Clays and Shales. By J. G. Phillips. Pp. 39. Department of Mines & Resources, Canada, No. 793. J. O. Patenaude, ISO, Ottawa. Price 25 cents.

This report covers the results of work carried out with the object of developing new methods of treating or processing clays to enhance their properties or to improve the finished ware made from them.

Department of Scientific and Industrial Research. Report for the Year 1937–1938. Pp. 203. H.M. Stationery Office, London. Price 3*s*.

This report summarizes the work during the past year of the various Boards, Committees, and Research Associations of the Department of Scientific and Industrial Research. Of particular interest is the work of the Lubrication Research Committee, whose further investigations on measurements of static friction and the physical properties of surfaces are referred to.

Reference is also made to the investigations by the Institution of Automobile Engineers Research Committee of the factors controlling ease of starting of engines from cold, more especially the power developed by an engine when it is just beginning to fire. This Committee has also developed a comparatively simple test for measuring the gum-forming propensities of lubricants, the results of which appear to agree, in general, with service.

Work has been continued on the investigation of various types of welding for gas cylinders and containers. It is stated that considerable amount of theoretical work on those properties of propane–butane mixtures which affect the design of containers—pressures and filling ratios—has also been carried out.

ABSTRACTS.

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Geology.

440. "Park City" Beds on South-west Flank of Uinta Mountains, Utah. J. S. Williams, *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 82–100.—It is considered that the "Park City formation" (as defined by Boutwell) is not a valid stratigraphic unit, and the name applied in that sense should be discontinued.

From faunal evidence obtained by the author it is shown that the lower member of the "Park City formation" is Lower Pennsylvanian in age, and the middle member apparently Middle Permian. Therefore, it is concluded, it is imperative that the "Park City formation" should be divided.

The upper member (Rex) and the middle member (Phosphatic Shale) may be extended from south-east Idaho, and can be recognized as far south-east as Ashley Creek. These members now constitute the Phosphoria formation.

The lower member of the "Park City formation" thins to the east on the south flank of the Uinta Mountains and dies out beyond the Duchesne River. On the north flank, to the east, it thickens and its limestone content is much increased.

Due to lack of available data, the true relationship of the lower member of the "Park City formation" is unknown, but on lithological characters the author is of opinion that it is merely a lithologic facies of the Weber formation. G. S. S.

441. Geologic Structure of St. George District, Washington County, Utah. C. E. Dobbin. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 121–144.—This paper gives a brief outline of the structural history, geological structure, and the results of deep drilling in the south-west corner of Utah.

Cambrian quartzite, with a thickness of 500 ft., lies unconformably on Pre-Cambrian metamorphics and granite. The quartzite is followed by rocks of the Carboniferous and Permian systems to deposits of Quaternary age. Frequent oscillations occurred during the transition from Palæozoic to Mesozoic times, with a period of uplift and erosion prior to the Cretaceous, and orogenic movements either in late Cretaceous or early Eocene.

Nearly the whole area lies west of the Hurricane fault and is divisible structurally into five easterly dipping monoclinal blocks, separated in part by major north-trending normal faults with the downthrow to the west. The faults are both straight and curved and terminate abruptly. They vary in vertical displacement along any one fault surface, and it is estimated their stratigraphic displacements are from about 1,500 ft. to nearly 5,000 ft.

The Virgin field (6 miles east-north-east of La Verkin) was discovered in 1907, and has produced a small amount of oil since that date. As a result of this discovery six deep wells have been drilled in the St. George district, but no economic quantities of oil or gas have been found. G. S. S.

442. Stratigraphy and Historical Geology of Gulf Coastal Plain in Vicinity of Harris County, Texas. W. G. Meyer. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 145–211.—In this paper a detailed study is made of the surface formations of an eastern Texas area, followed by an investigation up the regional dip to the outcrop of these formations. The results of the work are given in the form of a generalized comparison of the deposits in the area with those of south-west Texas and southern Louisiana.

The rocks occurring in the area are of Cenozoic age, and a notable feature concerning them is their great thickness, estimated at more than 24,000 ft. Moreover, it is shown that a gulfward thickening of the constituent formations takes place. As deeper drilling progresses in the Gulf Coast, so it becomes more certain that thickening continues as far as the present shore-line.

The deposits are alternately marine and continental, the oldest formation penetrated by wells drilled for oil in Harris Co. being the Crockett (Claiborne Group). A thickness of 1,465 ft. has been proved in the central part of the County. These Eocene beds, and others ranging through the Oligocene, Miocene, Pliocene, and Pleistocene, are described and also figured in a table.

The pre-Tertiary history of the Coastal Plain in the vicinity of Harris County is entirely conjectural, and conclusions must therefore be based on evidence farther inland, where more is known of the older rocks.

It has been proved that a geosyncline of major dimensions occurs near the outer margin of the Gulf Coastal Plain in eastern Texas and Louisiana; the axis is placed approximately at the site of the present shore-line of the Gulf. The formation of this huge depression and its accumulation of sediments (estimated to be 35,000 ft. thick) have played an important part in the Cenozoic history of the region. Discussion follows on the various theories of the origin of geosynclinal depressions.
G. S. S.

443. Geologic Aspects of Heaving Shale in Texas Coastal Plain. J. M. Frost. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 212–219.—Considerable time has been spent and a thorough search made for all fields and wells where heaving shale has been recorded in Texas Coastal Plain. This research includes all wells drilled prior to March 1, 1938.

As a result, it is found that there are five groups into which heaving shale wells may be divided: Lower Miocene, Middle Oligocene, Vicksburg, Jackson, and Yegua formations. The groups form belts or trends, have approximately the same width, and are parallel with the present shore-line of the Gulf of Mexico.

The fields and wells used to determine the various trends are shown in a table and a map is also supplied giving the location of these trends.

As hitherto there has been a lack of references on this subject, the author adds a comprehensive bibliography containing over fifty entries. G. S. S.

444. Petrography and Genesis of Asphaltic Rocks. III. Asphalt from Berseba, South-west Africa. H. Müller. *Bohrtech. Z.*, 1939, **57** (2), 21–24.—An asphaltic rock is found in the Fish River Sandstone at Berseba, South-west Africa, and the origin of this had been ascribed to hydrothermal action. Detailed examination of a hand specimen—thin sections, heavy minerals, character of the asphalt, etc.—has shown that it is a normal bituminous material in a rock composed mainly of Radiolaria remains. From a consideration of the heavy mineral residue it is suggested that the sedimentation of finely divided fragments of basic eruptive rocks so altered conditions that the organic matter of the Radiolaria was not destroyed by oxidation, and so was converted into asphalt. S. E. C.

445. Reservation of a Zone in Province of Salta, Argentina. Anon. *Bol. Inform. Petroleras*, Oct. 1938, **15** (170), 125–126.—Decree reserving for two years, from 28.9.38, a zone in the north of Salta, to allow of geological surveys being carried out with a view to locating mineral oil deposits. H. I. L.

Geophysics.

446. Application of Geophysical Methods in the Search for Oil. H. Jung. *Bohrtech. Z.*, 1939, **57** (2), 25–27.—The geophysicist makes use of certain physical characters of the rocks, the most important of which are density and the magnetic, electrical, and elastic properties. Thus it must be noted that geophysical methods are useless if the physical properties of the body sought are not different from those of the surrounding rocks. The application of these methods to the search for oil is based on the principle that oil occurs in certain geological structures, and if these can be discovered, then there is a chance of finding oil. The gravity, magnetic, electrical, and seismic methods are outlined. S. E. C.

447. Electrical Methods in Geophysical Exploration. H. M. Evjen. *Geologie en Mijnbouw*, Jan. 1939, **1** (1), 2–8.—Electrical methods can be divided into ore prospecting and structural prospecting, of which the former has had by far the greater success. This is probably due to the fact that for the latter the changes in value of the properties involved are much less than for ores, whilst the depths to be explored are greater.

In purely conductive methods, employing D.C., the conductivity alone determines the electrical field. In the magnetic method, in which a direct current is sent through a loop and the magnetic field is measured, the magnetic permeability by itself deter-

mines the results. In the other methods, in which alternating, commutated, or interrupted current is used, the parameters electrical conductivity, magnetic permeability, and dielectric constant are involved. Owing to the small variations in the last two, it is permissible to confine attention to the conductivity, even in electromagnetic methods.

Maxwell's Field Equations are examined from the point of view of absorption, and for practical purposes it is seen that for D.C. one half of the current penetrates a depth of one half of the electrode spacing, in uniform ground. This depth, which may be called the depth of penetration, is therefore proportional to the electrode spacing. In using A.C. the penetration is no longer proportional to the electrode spread, but reaches an asymptotic value as the spread is increased. This asymptotic value is approximately one-tenth of the computed wave-length, and may therefore be quite small, even at relatively low frequencies. This means that the parts of the earth shallower than the asymptotic value contribute preponderatingly to the result, no matter how great the electrode spread. Allowance must be made for absorption in interpretation; for failure to do so, in say the Wenner arrangement, gives apparent resistivities which are far too high. For the ground resistivities of 180–1,000 ohm cm., which are common, absorption cannot be neglected, even at very low frequencies and relatively short electrode spacing.

The modern tendency is towards lower frequencies and an approach to D.C., with the consequent elimination of inductive methods requiring relatively high frequencies. With suitably low frequencies for practical purposes it is permissible to use D.C. theory in interpretation. However, a truly three-dimensional method of interpretation is desirable. To separate deep from shallow effects in the D.C. method the electrode spacing is increased at the same location, but the resolving power of this process is low, due to the great distances and other complicating factors. To overcome these drawbacks the transient methods have been introduced. They are comparable to reflection seismography. However, the depth of reference of transient methods is still very small, owing to technical difficulties, and detailed and quantitative interpretations of the observations are not yet feasible. Nevertheless, this innovation seems to be a step in the right direction.

The seismic and electrical methods are compared. G. D. H.

448. Interpretation of Well-shot Data. C. H. Dix. *Geophys.*, Jan. 1939, **4** (1), 24–32.—The distribution of seismic velocity with depth is frequently determined by well-shooting. A method of interpreting well-shot data is presented which has the advantage that the velocity distribution can be made to fit the observations with any desired closeness. The method is not difficult to apply in practice, although with discrete data a unique interpretation evidently cannot be given. However, in the case of ideal data, including also surface refraction data, the velocity distribution can be determined uniquely. G. D. H.

Aerial Survey.

449. Aerial Observation and Photography in the Search for Oil. E. Fossa-Mancini. *Bol. Inform. Petroleras*, Sept. 1938, **15** (169), 51–97.—It is necessary to distinguish between aerial observation, aerial photographs taken obliquely, and those taken vertically. The first two serve for geological inspections, the last for geological and, under certain conditions, for topographical survey. The last-mentioned case suffers from difficulty of securing accurately vertical lens and correct bearings of plane at the instant of exposure.

Multiple cameras for taking simultaneously vertical and oblique views are useful; the oblique views enable recognition of fixed points in a survey, give indication of an outcrop showing marked resistance to erosion in a region which is otherwise not of great interest; they are also useful for instructional purposes. Advantages of direct observation :—

(*a*) It cannot be replaced by photos, as the latter do not reproduce colours, only light and shade, which again may be due to difference of colour or difference of light intensity, moreover—

(*b*) Panchromatic films are misleading, *e.g.*, a light grey rock will come out the same as a vivid red one.

(*c*) When observing, flight may be made at different heights and in any direction, so that the most favourable points for examination may be sought out and it is possible to swoop down momentarily to examine at close range a promising outcrop.

In this report the subject is treated in great detail and is illustrated by compound photographs; an historical section is included, as well as a very complete bibliography.
H. I. L.

Drilling.

450. Methods that Drilled Heaving Shale to 13,708 ft. in Aqua Dulce Field. C. A. Sullins and O. Van Dyke. *Oil Wkly*, 23.1.39, **92** (7), 52.—A string of 10-in. casing was set and cemented at 8,007 ft. in the Minnie Brown 1 well, as the geological section down to 8,000 ft. was thoroughly understood by the operating company and as large a hole as possible was required in which to work.

Drilling was carried out to a depth of 9,613 ft., when heaving shale prevented further progress. Cavities caused some trouble below 8,750 ft., and the mud was changed at this point to the silicate mud and the hole reamed to remove any accumulation of shale cavings.

From 9,613 ft. to 10,523 ft. the rate of drilling was 100 ft. per day with a fishtail bit. The first serious trouble after changing the mud occurred at 10,768 ft. Circulation was lost, and although efforts were made to regain it, it was not until attempts were made above 8,760 ft. that they were successful. Four days reaming and washing from this depth to 9,200 ft. yielded evidence that the cavities which had been developed in this interval were still actively enlarging and were not being cleaned out properly. Slow reaming effected the removal of the accumulated shale from the cavities.

The hole was carried to 10,792 ft. when two attempts to set a liner were made. It was found to be impossible to run this below 9,570 ft. It appeared from this that three major cavities had been formed between 8,800 and 9,600 ft. during the time of drilling with water and that no wall failure had occurred since drilling with silicate mud. This knowledge at this stage enabled the washing-out process to be used, and no further troubles from cavities occurred. A further practice which expedited the making of round trips was that of circulating for 15 to 20 min. after the removal of each 600–900 ft. of pipe. The pipe was therefore pulled in stages.

Wire-line coring was started at 10,676 ft., and the remainder of the hole was drilled with a wire-line core bit.
L. V. W. C.

451. Shifting of Rigs Cuts Drilling Costs. C. Johnston. *Oil Wkly*, 23.1.39, **92** (7), 61.—Delta Drilling Co. in the Schuler field are using a light rig for the first 5,000–6,000 ft., and are then replacing this by a heavy rig capable of reaching depths of over 7,700 ft. The object of this is that with locations ahead derricks are erected on the next location to be drilled, and the initial hole is drilled up to 6,000 ft. with a light rig, which is able to maintain maximum drilling speed up to this point. When the heavier rigs are released these are moved into position. By having two light rigs and one heavy rig and carrying out this programme, the same number of completions is secured as would be possible if all derricks were equipped with the heavy equipment. There is a loss of time in changing over, but this averages only from 16 to 22 hr., but the maintenance costs of the light rig are much smaller than those for the heavy rig, and the advantages are all in favour of the programme.
L. V. W. C.

452. World's Third Deepest Test Drills Record Heaving Shale Body. E. S. Post. *Oil Wkly*, 23.1.39, **92** (7), 30.—Union Producing Co.'s Minnie Brown 1 reached a depth of 13,728 ft., the last 5,000 ft. of which consisted of heaving shale. In spite of this handicap, at no time was the drill-pipe stuck. It is possible that the drilling methods used on this well may constitute, in some measure, the answer to the problem of fighting heaving shales. Careful supervision, extreme care, and drilling mud were the outstanding contributory factors in the drilling of this well, as no special technique was utilized in performing the drilling operations. Silicate mud was used and its physical

and chemical properties were checked and controlled constantly, and all cuttings from the hole were removed from the stream to eliminate contamination. Because of the rising temperature shown by the returning fluid, a mud-cooling system was installed. This device consisted of a series of nozzles through which the mud was sprayed into a cooling pit.

Pressures and speed of pumps, torque, and other factors that would reveal the condition of the hole were recorded continuously. L. V. W. C.

453. Drilling Footage Costs Cut by Special Wire Line Procedure. C. Johnston. *Oil Wkly*, 13.2.39, **92** (10), 32.—Normal drilling line costs in the Schuler field have been approximately 10·9 cents per foot of hole, but an innovation in drilling-line practice pioneered by the Delta Drilling Co. has cut the cost to slightly under 3·75 cents per foot of hole made.

Instead of buying the usual 1,250-ft. line, Delta buys a 2,000-ft. line and uses one end for starting a well. As work progresses this line is fed through the rig to distribute drum and sheave wear. The free end of the line is wound on to a storage reel which is provided with a friction brake. From the reel the line feeds on to the derrick floor, passing through jaws of a screw clamp, then making two or three complete turns around a drum equal to, or greater in diameter than, the sheaves over which the line is destined to work.

As new line is carried through the sheaves and on to the drum, it is necessary only to release the screw clamp and adjust the tension on the locking-drum until the required amount of line has carried over from dead storage to live service.

As new line gradually replaces that already having seen service, the ends of the line are exchanged.

With efficient splicing and using two lines which have each completed three wells the company has another 2,000-ft. line which in turn will make three holes before its service life is exhausted. L. V. W. C.

Production.

454. Gas-lift as a Production Method in East Texas Field. W. N. Rees. *Oil Wkly*, 13.2.39, **92** (10), 11.—With the continual improvement in gas-lift equipment and methods, gas-lift as a production method is destined to play an important part in the future production of the East Texas field.

Correct installation of the surface and sub-surface equipment is necessary if the desired efficiency of operation is to be obtained. Periodically running flow tests on the wells and repairing and resetting the flow valves in those wells where high gas-fluid ratios exist will keep the operating costs at a minimum.

Future gas-lift operations will use gas from the gasoline plants as well as extraneous high-pressure gas, as the gas available from the plants will be insufficient where large volumes of water have to be handled. The quantities of extraneous gas to be used will be dependent on the cost of gas and on future developments of high-pressure gas reserves. L. V. W. C.

455. Production Characteristics of some Typical Distillate Fields in the Gulf Coast Region. L. S. Reid and R. L. Huntington. *Oil Wkly*, 13.2.39, **92** (10), 23.—The development of many new deep fields in Texas and Louisiana has been retarded on account of the predominance of high gas–distillate ratios under which the wells in these fields must be produced.

Data provide evidence that most of the deep reservoirs in these areas contain a single-phase fluid under the initially high pressures which exist at the time of discovery. The holding of a high pressure within the reservoir will enable a single homogeneous fluid to be maintained, thus permitting depletion of the reservoir with a 160–640 acre spacing, where 10–40 acres might be economical for each well under ordinary oil-field conditions.

Any lowering of the pressure in these distillate reservoirs enables the sand-grains to become wetted with the condensate which could not be recovered easily.

As a result of the variations in distillate content in the Gulf Coast Field, it is important that detailed studies be made of the producing characteristics of these deep fields if they are to be operated on an efficient basis. L. V. W. C.

456. Methods Employed in the Upper Producing Levels' Tranquitas Zone (Salta, Argentina). J. O. Martinez. *Bol. Inform. Petroleras*, Nov. 1938, **15** (171), 13–30.—Characteristics of the deposits are given, together with a summary of the geological features, followed by a description of the methods adopted for maintaining the natural flow of oil. Broadly speaking, this consists in selecting two of the wells which indicate the lowest pressures at the bottom and using these for injecting gas (and possibly later on water) into the oil-bearing sands, and thus maintaining a steady flow of oil from the remaining wells in that group which draws its oil from the upper levels of the Tranquitas zone. H. I. L.

457. Important New Deposit at Tupungato (Mendoza, Argentina). Anon. *Bol. Inform. Petroleras*, Nov. 1938, **15** (171), 1–8.—Description of well No. T. 19, giving details of yield during the first days after completion of the new boring. Pressures up to 300 atm. had to be applied to control the surge of gas and oil. Between the 5th and 18th November, when the output was finally restricted to normal conditions, the total yield was 2,917 m^3. of oil, or a daily average of 208 m^3. A new well, T. 20, is being sunk to the north-east of T. 19, and is expected to be in production by the end of the year. H. I. L.

458. New Productive Area in Plaza Huincul. Anon. *Bol. Inform. Petroleras*, Nov. 1938, **15** (171), 9–11.—Three wells have been drilled in an area to the north of the mine "La Republica." Up to date their controlled daily yields amount to 54 cu. metres, and a fourth well is now being drilled. H. I. L.

Transport and Storage.

450. Engineering Significance of National Bureau of Standards Soil-corrosion Data. K. H. Logan. *Bur. Stand. J. Res. Wash.*, 1939, **22**, 109–125.—Approximately 33,000 specimens of various pipe materials have been buried by the Bureau of Standards in representative soils for the purpose of investigating the effect of soils on pipe-lines. However, the corrosion of pipe-lines depends on a number of factors, which makes it impossible to report fully underground-corrosion phenomena in terms commonly used for the reporting of corrosion data.

Thus data presented in previous reports do not give a clear idea of the corrosiveness of soils, and this is particularly important with respect to maximum pit depths.

A number of empirical equations have been developed for the purpose of expressing the relations of area, time, and maximum pit depths. No one equation, however, fits every set of pipe-line data better than any other.

A comparison of the computed pit depths with field experience has been attempted for a few soils. It is shown that although no close correlation should be expected, since experiences in the same soil may differ, the data indicate in a general way the corrosiveness of the soils tested. D. L. S.

Crude Petroleum.

460. Examination of Stavropol Crude. G. P. Grigoryev and W. W. Trophimov. *Neft. Khoz.*, January 1939, 22–25.—The Stavropol crude is classified as a heavy, methane–naphthenic crude oil with high asphalt, high sulphur, and low paraffin content. Laboratory fractionation yielded: gasoline (up to 150° C.), 10·1%; ligroine (150–200° C.), 7·7%; kerosine (200–275° C.), 15·3%; light gas-oil (275–300° C.), 6·9%—*i.e.*, light oil fractions (up to 300° C.) 40%; lubricating-oil fractions, 35·2%; heavy ends, 23·6%—*i.e.*, residual oil (above 300° C.), 59·3%.

The gasoline fraction of Stavropol crude is similar to Baku aircraft gasoline, its S content is within permissible limits, but the octane number is below 53. The ligroine fraction is unsuitable as a tractor fuel, owing to its low anti-knock value. Both fractions contain less aromatic compounds than the analogous fractions of Sysran crude. The chemical constitution and the boiling characteristics of the kerosine fraction correspond to the standards for illuminating kerosine, but its S content is high. The residual oil fraction has a high specific gravity and a viscosity similar to that of residual oil obtained from asphalt-base crude. The lubricating-oil fractions,

however, prepared from the residual oil have a low specific gravity, a high flash, and a high pour point.

Under full-scale refinery conditions, after deparaffinization and desulphurization, oils similar to intermediate grade oils from heavy crude will be obtainable.

From the heavy ends bitumins corresponding to the road bitumen standards can be produced. L. R.

Cracking.

461. Effect of Capacity on the Cost of a Cracking Plant. W. L. Nelson. *Oil Gas J.*, 23.3.39, **37** (45), 80.—The type of plant studied is the distilled oil re-circulation type. Three plants operating on a 24° A.P.I. Mid-Continent reduced crude were designed for capacities of 750, 1,500, and 3,000 brls. per day of reduced crude, and in addition two other designs of 1,500 brls. a day capacity operating on 21° and 27° A.P.I. stocks were examined. Percentage construction costs of the plants of varying capacity are tabulated under thirteen heads, and graphs show (1) total, material, labour, and overhead plus profit costs, plotted against (*a*) reduced crude capacity, (*b*) charge to pipe-still per day; (2) cost in terms of dollars per barrel per day against charging stock capacity.

In addition to higher construction cost per barrel per day, a small plant is also penalized by high supervision costs. A cost balance of each of the five plants is given using assumed values for intake and output products. These figures show not only the reduced percentage profit, but also the appreciably reduced profit in cents per barrel of charging stock, for the small plant as compared with the larger ones. Calculations are made of the increased price which must be obtained for raw gasoline produced or, alternatively, the reduced price at which feed-stock must be purchased by the small-plant operator in order to give a profit per barrel of stock processed similar to that obtained by the larger plant operator. R. A. E.

462. Patents on Cracking. Gulf Oil Corp. E.P. 499,839, 30.1.39. Appl. 30.7.37. Cracking of hydrocarbons to produce high anti-knock gasoline by treating the oil with normally gaseous hydrocarbons with 3–4 C atoms per molecule in an elongated conversion zone of restricted cross-sectional area under super atm. pressure.

E. W. Rembert. U.S.P. 2,146,553, 7.2.39. Appl. 22.7.32. Conversion of hydrocarbon oil by atomizing the liquid oil in its own vapour to produce fog or suspension of fine liquid particles. After removing the oil which is insufficiently atomized, the suspension is then mixed with hot gas, the heat of which vaporizes the liquid particles and subjects the vapours to a cracking reaction.

C. S. Read and V. W. Smith. U.S.P. 2,147,609, 14.2.39. Appl. 8.9.32. Direct-fired oil-heater for cracking operations. W. S. E. C.

Hydrogenation.

463. Plants for Hydrogenation of Fuels in Italy. G. Coppa-Zuccari. *Petrol. Z.*, 1939, **35**, 190–194.—Two plants, one at Livorno and one at Bari, are described which together are able to handle 300,000 tons of raw material per year, including among the finished products 100,000 tons of aircraft fuel. In the first place Albanian crude will be cracked and hydrogenated, but when the Albanian oil-fields are exhausted—which is expected within ten years—it will also be possible to use as raw materials oil shale from Sicily and lignite tar from Italy. The plants are said to be unique, in that solid and liquid products can be treated in every way possible. E. W. S.

464. Patents on Hydrogenation. H. E. Potts. E.P. 500,282, 6.2.39. Appl. 6.5.37. Production of diesel fuel by hydrogenation of heavy liquid carbonaceous material in the liquid phase at 350–420° C. and under at least 200 atm. pressure using WS or MoS as catalyst.

H. D. Elkington. E.P. 501,278, 21.2.39. Appl. 21.8.37. Hydrogenation of ethylene using silver catalysts prepared by subjecting silver or its compounds in an aqueous medium to H_2 in *statu nascendi*, *e.g.*, by the electrolytic reduction of a silver salt.

H. E. Potts. E.P. 501,318, 25.2.39. Appl. 7.5.38. Production of knock-stable motor spirit by hydrogenation of hydrocarbons obtained by synthesis of CO and H_2 using oxides or sulphides of Mo or W as catalysts.

N. V. International Hydrogeneerings-Octrooien Mij. E.P. 501,325, 24.2.39. Appl. 13.6.38. Hydrogenation of liquid olefine polymers of the gasoline boiling range using as catalysts sulphides of Mo and/or W and sulphides of Ni and/or Co.

M. Pier, W. Simon, and E. Donath. U.S.P. 2,149,900, 7.3.39. Appl. 12.11.34. Production of liquid hydrocarbon products of low-boiling point, from an unhydrogenated liquid carbonaceous material containing high-molecular substances of the nature of pitch, asphalt, resins, and similar substances which impair the activity of hydrogenation catalysts. The unhydrogenated material is distilled under atm. pressure without decomposition and completely distilled under reduced pressure to give an overhead fraction (free from high-molecular substances) and a pitchy residue. The overhead fraction and the residue are destructively hydrogenated, and the products obtained from the latter are returned to the initial distillation step.

H. Dreyfus. E.P. 500,264, 6.2.39. Appl. 5.8.37. Manufacture of hydrocarbons by the reaction of CO and H_2 in the presence of a hydrogenation catalyst. The absolute pressure in the reaction zone is normally above 0·5 atm., but is periodically reduced to below 0·5 atm. W. S. E. C.

Polymerization.

465. Patents on Polymerization. A. Wassermann. E.P. 499,958, 25.1.39. Appl. 25.5.37. Preparation of catalyst for the polymerization of high-molecular-weight substances from those of low molecular weight, consisting of a mixture of aluminium oxide or other metal oxides with an activated heavy metal sulphide with or without a carrier substance.

Distillers Co., Ltd., H. M. Stanley, G. Minkoff, and J. E. Youell. E.P. 499,969, 1.2.39. Appl. 9.8.37. Production of soluble polymerization products of styrene by heating a solution of styrene in *iso*propylbenzene in the presence of not more than 1% by weight of a hydrocarbon having at least 2 aliphatic $<C=CH_2$ groups separated by at least 2 C atoms, *e.g.*, *p*-divinylbenzene, 1 : 4-divinylnaphthalene, etc.

I. G. Farbenindustrie A.-G. E.P. 500,769, 15.2.39. Appl. 24.3.38. Polymerization of dienes in the liquid phase using anhydrous hydrogen halides as polymerization agents at below 20° below zero °C., separating the products boiling without decomposition under pressure of 10 mm. Hg by distillation or by treatment with a selective solvent and subjecting the remaining substance to a further polymerization.

Standard Oil Development Co. E.P. 501,145, 22.2.39. Appl. 2.9.37. Acid polymerization of straight-chain olefines, *e.g.*, *iso*butylene.

P. V. McKinney. U.S.P. 2,142,324, 3.1.39. Appl. 5.5.36. Preparation of catalysts for use in polymerization processes, consisting of silica gel activated with an aluminium salt.

F. W. Sullivan, Jr., and R. F. Ruthruff. U.S.P. 2,145,900, 7.2.39. Appl. 25.11.31. Conversion and stabilization of a mixture of hydrocarbons, at least a substantial portion of which is sufficiently stable to incorporate in motor fuel and a portion of which is of lower boiling range and too unstable to blend with motor fuel. The mixture is heated to 900–1,150° F. and under 750–3,000 lb. pressure/sq. in., and the total converted material is rectified to obtain uncondensed gases, a motor-fuel fraction, and a fraction intermediate in volatility between these gases and motor fuel; the intermediate fraction is then returned for reprocessing.

H. V. Atwell. U.S.P. 2,146,667, 7.2.39. Appl. 23.5.36. Production of liquid hydrocarbons from normally gaseous hydrocarbons containing unsaturated constituents by contacting the gaseous hydrocarbons with a catalyst in a heated reaction zone to effect polymerization.

H. Haeuber and F. Winkler. U.S.P. 2,147,838, 21.2.39. Appl. 29.10.36. Prevention of carbon deposition in polymerization reactions by using apparatus constructed of nickel-chrome steel.

P. V. McKinney. U.S.P. 2,147,985, 21.2.39. Appl. 29.6.36. Preparation of catalyst for polymerization of normally gaseous hydrocarbons into high-molecular-weight products, consisting of silica gel activated by an aluminium salt. The catalyst is prepared from gelatinous silica by the reaction of a soluble silicate and aqueous phosphoric acid.

H. L. Gerhardt and C. M. Hull. U.S.P. 2,148,115, 21.2.39. Appl. 19.6.36. Olefine polymerization into gasoline by forming a complex hydrocarbon compound of a boron halide and contacting the olefines at temperatures above the decomposition temperature of the said complex compound when the olefines are polymerized and the boron compound is decomposed.

H. L. Gerhardt and M. H. Arveson. U.S.P. 2,148,116, 21.2.39. Appl. 19.6.36. Conversion of gaseous hydrocarbons containing propylene and butylenes into liquid hydrocarbons by contacting them in an upright elongated reaction zone with gaseous boron fluoride. The latter forms a complex compound with the unsaturated hydrocarbons.

H. V. Atwell. U.S.P. 2,149,493, 7.3.39. Appl. 1.11.34. Production of motor fuel from cracked gases, which are first separated by fractionation into a normally gaseous fraction substantially free from H_2 and CH_4, a liquid fraction and a cracked distillate, both the liquid fraction and the distillate having a lower initial and end boiling point than those of the final product. The liquid fraction and the normally gaseous fraction are separately polymerized, and the gasoline-like products are blended with the cracked distillate.

H. Velde and H. Tramm. U.S.P. 2,149,562, 7.3.39. Appl. 24.4.37. Production of motor fuel by polymerization of gaseous olefines without catalysts, in which the cross-section area of the stream of gas is gradually reduced as polymerization progresses.

Le R. G. Story. U.S.P. 2,149,800, 7.3.39. Appl. 23.7.36. Conversion of high-boiling hydrocarbons into low-boiling hydrocarbons such as gasoline by treatment with O_2 or oxygenated gases. The large amount of gaseous products formed is divided into a lighter fraction containing oxygenated gas and a heavier fraction. The lighter fraction is recycled and the heavier fraction is polymerized. W. S. E. C.

Synthetic Products.

466. Synthesis of Hydrocarbons and the Production of Lubricating Oils. Anon. *Report of Fuel Res. Board for year ending* 31.3.38, 186–206.—An investigation has been carried out into the mechanism of the Fischer–Tropsch reaction. Work has also been done on the preparation of suitable catalysts, and the most satisfactory one found consisted of cobalt promoted with thoria and supported on acid-washed kieselguhr.

Semi-technical scale-runs have been made on a plant designed for an input of 100–150 cu. ft. synthesis gas per hour. The highest yield of recovered oil product was 77·0 gm./normal cu. m. gas, which is somewhat lower than yields obtained on the laboratory scale plant.

The spirit from the charcoal scrubbers and the directly condensed oil have been investigated and experimental data are given.

The oil obtained by this synthesis contains olefines which can be polymerized to lubricating-oil fractions. This has been carried out on a semi-technical scale using $AlCl_3$ as catalyst.

The resultant product showed good characteristics in regard to coke numbers, before and after oxidation, setting point, flash point, whilst its other properties were up to average values for mineral oils. However, the change of viscosity on oxidation was greater than is usually given by good mineral oils.

The polymerization of gaseous olefines has been studied, and work has also been carried out on the formation of esters by the direct union of olefines and acids.
D. L. S.

467. Patent on Synthesis. Ruhrchemie A.G. E.P. 500,182, 1.2.39. Appl. 1.5.37. Production of catalysts for benzine synthesis from CO and H_2 using a catalyst of the iron group prepared by precipitating the catalytically active substance in the presence of a carrier metal. W. S. E. C.

Refining and Refinery Plant.

468. Control of Wax Distillate Quality. Part III. L. L. Davis and A. Nelsen. *Nat. Petrol. News*, 11.1.39, **31** (2), R. 14.—A routine laboratory vacuum distillation apparatus and procedure have been developed which give sufficiently reproducible results for accurate wax-distillate control. For a given crude source and commercial distillation unit the viscosity-mid-distilling temperature characteristic may be used to estimate pale oil yields. In the case of distillates from different crudes or from different distillation units, it is necessary to use viscosity–temperature characteristics of the dewaxed distillate to estimate relative pale-oil yields from different distillates.
H. G.

469. Control of Wax-Distillate Quality. Part IV. J. W. Donnel. *Nat. Petrol. News*, 25.1.39, **31** (4), R. 34.—An investigation of the pressing and sweating characteristics of a number of Oklahoma waxy distillates is described. A standard procedure was used throughout, and it was concluded that although the distillation range of a wax distillate is a valuable measure of the quality and uniformity of such distillate from a given source, it is not an inherent characteristic and is not necessarily an absolute criterion of quality. The pale-oil yield of a wax distillate depends on the distillation range, viscosity/temperature characteristics, and the wax content of the distillate. Viscosity, wax content, and the crystal structure of the wax are the factors affecting pressability. Pressing efficiency or wax yield are affected by the condition of the press, operating conditions, and crystal structure. The yield of scale wax from the sweating process depends principally on the oil content of the slack, which in turn is dependent on the efficiency of pressing. H. G.

470. Solvent Dewaxing and its Bearing on Manufacture of Waxes. R. Lee and E. S. Nicholls. *IIme Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 9–13.—The authors discuss solvent dewaxing with reference to character and quality of the wax removed from oil by this method. It is possible to obtain "slack wax" or petrolatum (according to the stock which is treated) with a much lower oil content than in the products obtained by cold-pressing or cold-settling and centrifuging. High-melting petrolatums and petroleum ceresins may be made by sufficiently well separating wax from oil.

A slack wax containing a wide range of waxes may be first distilled *in vacuo* to remove distillate wax, which may be sweated in the usual way. The high-melting residue may yield petrolatum or petroleum ceresin. P. G. H.

471. Progress in Centrifugal De-waxing. B. K. Engel and N. O. Backlund. *IIme Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 25–30.—A description of modern methods for the continuous centrifugal separation of wax from oils and residues of varying origins. The choice of a suitable solvent is made after laboratory trials. Special importance is attached to the "heavy solvent" process, in which chlorinated hydrocarbons are used, either alone or in admixture with other solvents. P. G. H.

472. Differentiation of Paraffins and Centrifugal Dewaxing. M. B. Brute. *IIme Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 43–53.—The microscopical appearance (polarized light) of Pechelbronn distillates is used to decide when dewaxing must be effected by centrifuging in place of cold pressing. Pressable wax appeared as large, ribbon-like crystals. Non-pressable wax consisted of short, fine needles. The presence of a proportion of crystallizable wax (derived from lighter fractions of the

oil) in non-pressable distillate did not influence microscopical appearance, but caused considerable increase in pour point of oil after centrifugal dewaxing. After removal of the light wax fractions by steam distillation it is possible to obtain oils with good pour points.

From their refraction and crystalline appearance the oil waxes for the heavier distillates were judged to approach ozokerite ceresin. Re-distillation without vacuum converted them into crystallized paraffins. X-Ray spectra show that this transformation is due to molecular chain shortening. P. G. H.

473. Microscopical Control of Dewaxing. J. Ferraud. *IIme Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 55–62.—A definite relationship has been observed between the crystalline form of paraffin wax and the efficiency with which dewaxing may be effected, either by cold pressing or by centrifugal treatment.

A technique is described for studying the various fractions from a vacuum distillation bench by means of a polarizing microscope. The information so obtained enables the appropriate dewaxing conditions to be applied and may be of assistance in investigating dewaxing difficulties. P. G. H.

474. "Carrier" Distillation Process for Asphalt and Lubricants. W. W. Kraft and W. J. Bloomer. *Nat. Petrol. News*, 22.2.39, **31** (8), R. 58.—The process is a development of the well-established principle of the application of the partial-pressure effect by the introduction of a third vapour for the purpose of better fractionation. In considering the substitution of steam as the "carrier" the desirable characteristics of the carrier are: (*a*) low molecular weight, (*b*) ability to condense completely at reasonably low pressures, (*c*) final boiling point should be at least 50° below the initial boiling point of the residue. In the Coubrough process a light, non-viscous distillate such as gas-oil or kerosine fulfils these requirements. It is mixed with the charging stock and removed from the top of the vacuum fractionating tower and re-circulated. The innovation is claimed to increase the flexibility of the plant and the quality and yield of the lubricating-oil fraction. H. G.

475. Influence of Distillation Conditions on Characteristics of Mineral Oils. A. Hanriot and R. Weick. *IIme Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 71–75.—The authors distilled crude oils by high vacuum and by steam-distillation processes and determined the viscosity, refractive index, and A.S.T.M. carbon-test characteristics of the resulting distillates. They show that the method of distillation appreciably affects these characteristics. Up to viscosities of Engler 100° at 50° C., the carbon-test figures and refractive indices are substantially identical for oils of equal viscosity whether produced by high vacuum or by steam distillation. Above this viscosity limit the high vacuum oils have carbon-test figures and refractive indices appreciably worse than the others, indicating the presence of products other than those originally present in the crude produced by thermal decomposition.

Viscosity–Carbon Test and Viscosity–Refractive Index graphs are a useful means of control, since abnormal points indicate the presence of such products. W. P.

476. Refining Lubricating Oils with Aniline. A. V. Kirsanov and A. F. Novikova. *Nat. Petrol. News*, 28.12.38, **30** (52), R. 616.—Pure aniline has been used as a selective solvent in the refining of a 290–350° C. cut from Chusovsky crude. Aniline was used in proportions varying from 1 : 4 to 2·5 : 1 and at temperatures varying from 0° C. and 20° C., and was recovered from the extract by washing with dilute HCl. The oils were separated into two fractions which differed from each other by the following amounts: density, 0·04–0·08; refractive index, 0·023–0·096; iodine value, 8–11; average molecular weight, 21–46. The sulphur content of the original oil was 5·4% weight and the separated fractions contained 0·3–1·5% more and 1·5–2·4% less sulphur, respectively, than the original oil. The considerable differences between the properties of the separated fractions are taken as an indication that aniline has a selective action on different and definite hydrocarbons and that it dissolves aromatic bodies and certain sulphur bodies, leaving paraffinous bodies and other sulphur compounds undissolved. H. G.

477. Boiling-Film Heat-Transfer Coefficients in a Long-Tube Vertical Evaporator. G. W. Stroebe and E. M. Baker. *Industr. Engng Chem.*, 1939, **31** (2), 200.—A vertical tube 1·76 in. i.d. 20 ft. long was arranged so that it could be fed at the base with liquid (water, sugar, or "Dupanol" solutions) at the boiling point. The tube was steam heated. Feed rates varied from 250 to 2,000 lb. per hour. The results were correlated by the equation:

$$h_l = \frac{7{\cdot}8 \times 10^6 \times v^{0{\cdot}1}}{\left(\frac{C_p\mu}{k}\right)^{0{\cdot}3} \sigma^2 (\Delta t_l)^{0{\cdot}13}}$$

where h_l = boiling liquid film heat-transfer coefficient, B.T.U./(hr.) (sq. ft.) (°F.).
v = specific volume of vapour, cu. ft./lb.
σ = surface tension, dynes/cm.
Δt_l = liquid film temperature difference, °F.
C_p = specific heat, B.T.U./(lb.) (°F.).
μ = viscosity, lb./(ft.) (hr.).
k = thermal conductivity, B.T.U./(hr.) (sq. ft.) (°F./ft.).

The variables are based on the average liquid temperature, and this may be estimated by means of a chart as a function overall temperature difference, vapour head temperature, feed rate, liquid specific gravity, and specific volume.

The work does not allow terms to be included for the dimensions of the tube, but recalculation of the work of other observers on the basis of the above equation indicates a trend towards lower coefficients with decrease of boiling length. P. D.

478. Liquid Velocity and Coefficients of Heat Transfer in a Natural Circulation Evaporator. A. S. Foust, E. M. Baker, and W. L. Badger. *Industr. Engng Chem.*, 1939, **31** (2), 206.—Experiments were made on the evaporation of water in a basket-type evaporator containing thirty-one 2·5 in. o.d. tubes 48 in. long. The effects of temperature drop and boiling point on the heat transfer coefficients and rate of circulation were investigated. P. D.

479. Steam-Film Heat-Transfer Coefficients for Vertical Tubes. E. M. Baker, E. W. Kazmark, and G. W. Stroebe. *Industr. Engng Chem.*, 1939, **31** (2), 214.—Steam-film coefficients were measured for a vertical tube 2 in. o.d. 20 ft. long. The results obtained, together with those of other workers using tubes of different length, can be represented by the equation:

$$h_s\left(\frac{\mu^2}{\rho^2 k^3 g}\right)^{\frac{1}{3}} L^{\frac{1}{3}} = 0{\cdot}29\left(\frac{k\Delta t_s}{\mu\lambda}\right)^{-0{\cdot}2}$$

where h_s = steam film coefficient, B.T.U./(hr.) (sq. ft.) (°F.).
μ = viscosity, lb./(ft.) (hr.).
ρ = density, lb./cu. ft.
k = thermal conductivity, B.T.U./(hr.) (sq. ft.) (°F./ft.).
L = length of tube, ft.
Δt_s = steam film temperature difference, °F.
λ = latent heat of condensation, B.T.U./lb. P. D.

480. Extension of Plant at the Destileria Fiscal de la Plata. Anon. *Bol. Inform. Petroleras*, Nov. 1938, **15** (171), 104–106.—Decree authorizing installation of a topping, cracking, and polymerization plant at the above works for the purpose of securing an improved grade of petrol from the crude oils dealt with there. H. I. L.

481. Patents on Refining. Manvers Main Collieries, Ltd., W. F. Carr, T. G. Woolhouse, and W. Green. E.P. 501,077, 21.2.39. Appl. 4.10.37. Steam treatment of acid sludge from mineral oil and benzole refining to recover hydrocarbons and dilute acid.

W. W. Kraft. U.S.P. 2,149,058, 28.2.39. Appl. 15.11.35. Method and apparatus for the fractional distillation of petroleum oils.

W. J. von Piotrowski and J. Winkler. U.S.P. 2,151,147, 21.3.39. Appl. 23.10.37. Preparation of organic compounds from acid sludge obtained from the refining of mineral oils.

R. L. Rude. U.S.P. 2,152,155, 28.3.39. Appl. 30.9.35. Method of protecting vacuum-creating equipment of distillation plants. W. S. E. C.

482. Patents on Distillation. Kodak, Ltd. E.P. 500,195, 30.1.39. Appl. 29.7.37. An improved vacuum distillation apparatus.

J. H. W. R. Van Tonningen. U.S.P. 2,149,943, 7.3.39. Appl. 23.12.35. Method of fractionation of hydrocarbons. W. S. E. C.

Chemistry and Physics of Petroleum.

483. Effect of Pressure on Viscosity of *n*-Butane and *iso*Butane. B. H. Sage, W. D. Yale, and W. N. Lacey. *Industr. Engng Chem.*, 1939, **31** (2), 223.—The viscosity of gaseous and liquid normal- and *iso*butane was measured over the temperature range 100–220° F., and at pressures up to 2,000 lb. per sq. in. The results are given in tabular and graphical form. P. D.

484. Separation Processes: Separation of Isotopes by Fractional Distillation of Water. M. Randall and W. A. Webb. *Industr. Engng Chem.*, 1939, **31** (2), 227.—A description of the construction and method of operation of two packed columns used for concentrating deuterium oxide from water. P. D.

485. New Reaction for Unsaturated Hydrocarbons and Peroxides. E. L. Lederer. *IIme Congrès Mond. Pétrole*, 1937, **2** (Sect. 2),, 85–89.—The author studies colorimetrically the reaction between unsaturated bodies and salts, formed by the combination of metals exhibiting variable valencies, with carboxylic and sulphonic acids of the aliphatic, aromatic, and hydro-aromatic series. Co and Mn salts are stated to be most suitable for this purpose and a high sensitivity is claimed.

Parallel with the above colour reaction, the formation of peroxides has been established in an appreciable amount for the unsaturated hydrocarbons and in less quantities for the saturated hydrocarbons.

The author has used the reaction of the Mn salts for the estimation and elimination of peroxides.

A method is described for the elimination of sulphur and its components by the use of Ag salts. J. K.

486. Thermal Stability of Butane and *iso*Butane. G. R. Schultze and H. Weller. *Oel u. Kohle*, 1938, **14**, 998–1011.—The apparatus used in this work is described in detail and illustrated by diagrams, showing how it can be used to investigate the kinetics of the decomposition both of the pure butanes and of mixtures of them with nitrogen. Two methods were used for analysis of the resultant hydrocarbons based on fractional distillation at low and atmospheric pressures, respectively. Olefines were confirmed by absorption in a solution of mercuric nitrate in nitric acid saturated with sodium nitrate.

As a result of analyses of the products of decomposition, it was deduced that the primary reactions at 700° C. were :—

In the case of *n*-butane :—

$$n\text{-}C_4H_{10} \longrightarrow C_4H_8 + H_2 \quad . \quad . \quad . \quad . \quad . \quad . \quad 15\%$$
$$n\text{-}C_4H_{10} \longrightarrow C_2H_6 + CH_4 \quad . \quad . \quad . \quad . \quad . \quad . \quad 54\%$$
$$n\text{-}C_4H_{10} \longrightarrow 2C_2H_4 + H_2 \quad . \quad . \quad . \quad . \quad . \quad . \quad 16\%$$
$$n\text{-}C_4H_{10} \longrightarrow C_2H_4 + C_2H_6 \quad . \quad . \quad . \quad . \quad . \quad . \quad 13\%$$

In the case of *iso*butane :—

$$iso\text{-}C_4H_{10} \longrightarrow iso\text{-}C_4H_8 + H_2 \quad . \quad . \quad . \quad . \quad . \quad . \quad 52\%$$
$$iso\text{-}C_4H_{10} \longrightarrow C_3H_6 + CH_4 \quad . \quad . \quad . \quad . \quad . \quad . \quad 48\%$$

In the first case the primary decomposition consists in the breaking of bonds in the middle and at the end of the molecule, with evolution of hydrogen, whereas in the latter the bonds at the ends of the molecule only are broken.

The influence of temperature and pressure and of the presence of inert diluents was investigated, and the results were recorded with numerous tables and diagrams. Velocity constants are given for the different reactions, and their dependence on temperature is illustrated. Finally, from considerations of the kinetics of the reactions, it was concluded that chain reactions, resulting from the production of free radicals, play an important part in the complex decomposition. T. T. D.

487. Stereoisomeric Hexaethyl*cyclo*hexanes. H. Koch and H. Steinbrink. *Brennst Chemie*, 1.11.38, **19** (21), 407, 408.—In continuation of previous investigations (Abstr. No. 1331, 1938) a new hydrocarbon has been isolated having a melting point of 104·7–105·0° C., and has been identified as the solid stereoisomeric hexaethyl*cyclo*hexane. Elementary analysis yielded: 85·51; 85·61% C, and 14·33; 14·46% H (calculated 85·62% C; 14·38% H). Molecular weight was found to be according to Beckmann 250, 251, 253; according to Rast 248; and ebullioscopic according to Riesche 246; theoretically 252. L. R.

488. Chemical Constitution and Viscosity, with Reference to Benzene Hydrocarbons with Longer Side-chains. A. W. Schmidt, G. Hopp, and V. Schoeller. *Oel u. Kohle*, 1938, **14**, 985–990.—Distillation, fractional crystallization, selective solvents, and adsorption have all been suggested, without success, as instruments to aid in the separation of pure compounds from lubricating oil or to throw light on its constitution. An alternative is the synthesis of lubricating oil-like substances of known composition and comparison of properties with those of natural lubricating oils. A most important property for this purpose is the viscosity–temperature relationship.

The dependence of this relation on chemical constitution is shown by plotting "m" (the constant from the Walther formula) against the number of carbon atoms in the molecule. In the series C_6H_5–C_nH_{2n+1}, a smooth curve is obtained, "m" decreasing as the number of carbon atoms in the side-chain increases. From the data on paraffins published by Evans, the authors show that in this series too the value of "m" decreases with increasing chain-length, and attribute their similar results with the alkylbenzenes to the increasing importance of the side-chain as its length increases and the molecule becomes essentially paraffinic.

The authors observe a similar relationship between "m" and the number of carbon atoms in the molecule in the monochlorparaffins.

By extrapolation, it should be possible to estimate, from measurements on lower members of the series, the viscosity–temperature relationship of higher members, which would be very difficult to synthesize and measure directly. Reciprocally, from the viscosity–temperature relationships of the natural lubricating oils it may be possible to obtain a clue as to their composition. T. T. D.

489. Experimental Researches on the Inflammability of the Vapours of Some Combustible Liquids. J. Baron. *Ann. Off. Combust. liq.*, 1938, (5), 875–947.—After a discussion of the theory and previous work, the apparatus used is described. The method used is the static method, sometimes called the pyrometer method. The effect of different oxygen-combustible ratios was tried together with the effect of inert gases, *e.g.*, N_2 and CO_2, all experiments being carried out at pressures of 700 mm. of mercury or lower. Inhibitors, such as acetaldehyde and $PbEt_4$, were also tried. With ethyl ether increase in the concentration of N_2 lowers the spontaneous ignition temperature (S.I.T.), and a decrease in the oxygen ratio from 6 to 0·5 : 1 causes a slight increase. CO_2 also causes a decrease in S.I.T., but lowering the pressure causes a slight increase. These results conform with what would be expected from the chain theory. Additions of acetaldehyde and $PbEt_4$ cause an increase in the S.I.T. The condition of the walls of the pyrometer affect the results, and it was found that after the use of $PbEt_4$ it was impossible to reproduce previous figures, apparently due to PbO having combined with the glass. The critical pressure of inflammability gives the critical temperature = 221 $\pm$ 0·5° C. for mixtures of ether, oxygen, and

inert gas. It is also found that the product of the partial pressures of ether and oxygen equal a constant, K = 49. Normal propyl ether behaves in a similar manner to ethyl ether. Experiments with acetaldehyde show that pressure has a much greater effect than with ethyl ether. Also increasing the richness of the mixture gives first a lowering and then an increase in the S.I.T. H. L. W.

490. Separation of 1 : 2 : 4-Trimethyl*cyclo*hexane and an *iso*Nonane from a Mid-Continent Petroleum. J. D. White and A. R. Glasgow, Jr. *Bur. Stand. J. Res. Wash.*, 1939, **22**, 137–152.—A fraction b.pt. 130–145° C. from an Oklahoma crude was treated with liquid SO_2 to extract aromatics, the immiscible portion redistilled, and the fraction boiling at 140–145° C. treated with silica gel.

The residual oil consisting of paraffins and naphthenes was then distilled at 215 mm. Hg and separated into two main fractions, one b.pt. 101–102·2° C. and already dealt with, the other b.pt. 98–99° C.

The latter fraction was found to consist of nonanaphthenes and *iso*nonanes, and was separated by distillation at 215 mm. Hg into one portion containing the bulk of the naphthenes and another rich in paraffins. From the former nearly pure 1 : 2 : 4-trimethyl*cyclo*hexane was isolated by crystallization from solution in dichlorodifluoromethane, whilst continued distillation of the latter at normal pressure alternated with distillation at 215 mm. Hg yielded a fraction containing 85 mole-% of an *iso*nonane—probably 2 : 3-dimethylheptane.

With reference to this method of separation of the paraffinic fraction, it is a general principle that with paraffins, naphthenes, and aromatics boiling at nearly the same temperature, members of one class differ materially from those of another class in the change of their vapour pressure with temperature. Because of this, a binary mixture composed of a paraffin and naphthene boiling close together can have the partial pressures of its components so altered as to enhance their separation by fractional distillation or to reverse the order in which they distil.

The boiling point, freezing point, density, refractive index, and critical solution temperature in aniline have been determined for the 1 : 2 : 4-trimethyl*cyclo*hexane and the *iso*nonane.

Comparison of the properties of the naphthene with those reported for its synthetic stereoisomers indicates that the petroleum hydrocarbon is either 1-$_{cis}$-2-$_{trans}$-4-$_{cis}$-trimethyl*cyclo*hexane, or 1-$_{cis}$-2-$_{trans}$-4-$_{trans}$-trimethyl*cyclo*hexane.

This naphthene constitutes about 0·1% and the *iso*nonane about 0·05% of the original petroleum. D. L. S.

491. Summary of an Investigation of the Composition of a Mid-Continent Petroleum Distillate Boiling between 100° C. and 130° C. R. T. Leslie. *Bur. Stand. J. Res. Wash.*, 1939, **22**, 153–170.—This paper summarizes the work done since 1929, and includes some new information obtained since the publication of previous specialized and summary papers.

About 6% vol. of the total crude distilled between 100 and 130° C. and 130 litres of this fraction were obtained after the first laboratory distillation. The constituents of about one-sixth of the volume of this fraction were identified or characterized by physical properties, isolated or concentrated, and their concentration in the crude estimated.

About ¼ vol. remained as unidentified distillate, and consisted of about one-twelfth vol. of material, of which the constitution was only predicted, and about ⅛ vol. of additional quantities of constituents isolated previously. The remainder was lost during the investigation or fell outside the range on subsequent distillations.

Photomicrographic studies were made of those concentrations of distillates which could be crystallized.

A table is included which summarizes most of the conclusions reached in the investigation. This gives, in addition to the relative quantities of constituents actually isolated, conclusions as to the probable presence or absence of each of the other hydrocarbons boiling at 98–131° C. on which data have been found in literature. D. L. S.

See also Abstract No. 530.

Analysis and Testing.

492. Determination of Gum in Oils Heavier than Kerosine. F. L. Smith and E. B. Shannon. *Refiner*, 1939, **18**, 53.—According to the authors, the following method of estimating gum is suitable for oils to which the air jet method (A.S.T.M. D.381 34T) cannot be applied. 100 ml. of the sample are diluted with 50 ml. 80° petroleum naphtha in a 500-ml. separating funnel and 20 ml. of absolute ethanol are added. After 30 sec. vigorous shaking 10 ml. of distilled water are added and a swirling motion is applied. The emulsion is allowed to break, adding 5 ml. water if necessary. The alcohol–water layer is transferred to a beaker. The extraction is repeated twice on the oil layer. The total alcohol–water extract is washed with 80° naphtha to remove any oil, then evaporated in a tarred glass dish on a steam bath, and finally heated for 12 hr. in a constant-temperature oven at 212° F. to 220° F. G. R. N.

493. Miscibility Relations in Solvent Dewaxing. F. W. Hall and B. Y. McCarthy. *IIme Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 15–24.—The factors involved in the choice of conditions for dewaxing by means of ketone–benzol solvent are discussed.

A cloud-point test makes it possible to establish temperatures of initial separation of wax, oil, solid benzol, and water. An apparatus is described and interpretation of phase diagrams is explained.

A method of determining wax content in charge stock is also given. This is based on the change in the ratio solvent in waxy solution : solvent in dewaxed filtrate. P. G. H.

494. Observations on Fractionation of Paraffins. M. Bertrand. *IIme Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 31–34.—The melting point of paraffin contained in a given distillate or re-cycled product may be gauged from the congealing point of the paraffinous oil (cooling curve, rotating thermometer, or A.S.T.M. methods may be used). Curves are given showing relationship between percentage paraffin of different melting points and congealing point of oil. The relationship is linear above 40% paraffin content. A curve is also given showing corrections for various viscosities of oil.

Practical applications of the curves are given, of which the chief is the calculation of the proportion and melting point of paraffin contained in a paraffinous oil. In this case it is necessary to know the density, congealing point, and viscosity of the oil before and after cold filtration. P. G. H.

495. Identification of Paraffin in Ozokerite/Paraffin Mixtures. P. Woog, J. Givaudon, and Chmelevsky. *IIme Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 35–41.—The authors discriminate between paraffin and ozokerite by means of the high-melting constituents which characterize ozokerite.

Distillation curves of paraffin (obtained by distillation in cathodic vacuum) are regular, whilst those of ozokerite, or mixtures with paraffin, consist of two parts. The second, steeply rising part of the curve relates to the high-melting constituents. The detection of fractions melting at least at 85° C. indicates that ozokerite is present. A fractional crystallization from solution at 0° C. may be used in place of distillation. P. G. H.

496. Estimation of Paraffin in Petroleum Products. A. Spack. *IIme Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 67–69.—In the usual methods of precipitating wax from oil by means of solvents it is found that variation in melting point and percentage wax occurs from one test to another. The author's method is based on simultaneous variation in the percentage and melting point of wax precipitated from a given solvent at different temperatures.

The relationship between percentage and melting point of wax is linear. It is possible to read off from graph the proportion of wax of any selected point which is obtainable from an oil.

If acetone be used as the solvent, asphaltic material is precipitated, and may be filtered off before the oil–wax solution is cooled. P. G. H.

497. Standard Method and New Apparatus for Analyses of Pyroschists and Lignites. J. Barlot. *IIme Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 77–80.—The author describes a method of analysis and an apparatus for the quantitative estimation of yields of oil by pyrolysis. Analysis involves (*a*) the determination of the total organic matter, which is dispersed in a mineral mass which has to be eliminated, (*b*) the assessment of the quality of the material by processing quantitatively to determine oil yield.

The method of analysis consists in subjecting a well-pulverized sample to the following procedure: (1) remove soluble bitumens by extraction with benzene, carbon tetrachloride, etc.; (2) extract with HCl to remove carbonates of alkaline earths, iron, and aluminium salts, etc.; (3) extract with HF and H_2SO_4 to remove silicates. The residue then consists of organic matter together with pyrites and traces of silica. These are determined on aliquot portions, thus giving total organic material.

The method of processing consists in heating about 1 kg. of material in an iron tube in an electric furnace and collecting the water and oil so formed in a series of washers. The apparatus is described in detail and permits of the process being carried out either with or without a stream of inert gas or with a stream of reactive gas, *e.g.*, hydrogen. The amounts of water, oil, and sulphur products (namely, H_2S) are measured. W. P.

498. Continuous Distillation Apparatus for Laboratory Use. G. de Ponte. *IIme Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 81–83.—The apparatus, which is based on the principles of Walther, is designed to reproduce industrial pipe-still conditions on a laboratory scale. It consists of a long metal tube wound in a spiral and immersed in a molten metal bath. The temperature of the bath is regulated by a thermo-regulator which controls the temperature of the liquid leaving the tube. The fractionating column consists of a long tube having an internal reflux and divided into a number of units, each having a worm condenser actuating the reflux. A thermo-regulator controls the temperature of each unit. The bottom of the column has an annular space to receive the condensate. The whole apparatus is heat insulated. Receiving vessels are connected by means of normal ground joints to each unit of the column, these being in turn connected to a common vacuum line. The apparatus permits all the operations of distillation and rectification to be carried out at atmospheric pressure, *in vacuo*, under pressure, and in a current of steam. The distillation speed should not be allowed to exceed 2–3 litres/hr. in order to maintain the internal pressure at a few mm. of Hg. If mercury-vapour pumps are employed, it is essential to insert a froth separator, in order to prevent the formation of mixed oil–mercury vapours which corrode the pumps. It is also possible to collect the " dry " gases by connecting a silica-gel tube to the common vacuum and/or pressure line. M. M. L.

499. Simple Calorimeter for Rapid Determination of Calorific Values of Liquid Fuels. P. Woog, J. Givaudon, and Paulette Dacheux. *IIme Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 91–95.—A calorimeter consisting of a direct-reading thermoelectric Fery bomb is described. Temperature rise is appreciable, rapid, and regular, and is measured by means of a thermocouple, the recording millivoltmeter being calibrated to record calorific values directly. The original form of apparatus was not reliable, but satisfactory results are claimed for a modified form of Fery bomb immersed in a liquid of low specific heat (perchlorethylene). M. M. L.

500. Determination of the Vapour-locking Tendency of Gasolines. P. Woog, R. Sigwalt, and Mlle. de Mouillac. *IIme Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 97–100.—The gasoline under test is led, by way of a constant-level device containing a carburettor float valve, through a copper spiral (1) and a specially designed, vertical glass tube (2). (1) and (2) are immersed in a water-jacket through which water from a thermostat at any desired temperature can be passed. A water-pump and Mariotte tube connected to the other end of the system maintain a constant vacuum of 1 m. of water. One type of tube (2) contains a glass bell fitted with a metallic diaphragm, the other has a bulb blown eccentrically to its axis, whereby in each case the appearance of vapour-lock in the system can be observed.

The temperature of the water in the water-jacket is raised until vapour-lock makes

its appearance, when the temperature is noted. Although the results obtained on fuels by this method class them in the same order as their vapour pressures (Reid), the authors do not consider that this is conclusive, as only ten fuels have been examined. T. M. B. M.

501. Graphical Representation of Control Tests Employed in Petroleum Refining. R. Pimor. *IIme Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 101–106.—A chart of tests is given in which tests are listed as abscissæ and products as ordinates, symbols being used to indicate for each product the tests which are essential, auxiliary, unnecessary, and impossible. From this it is immediately apparent as to which tests must be applied to a certain product and to which products a given test is applicable. W. P.

502. Advances in the Technique of Desorption Gas Analysis. R. Henjes. *Oel u. Kohle*, 1938, **14**, 1079–1083.—The author gives a full description of apparatus for the analysis of mixtures of hydrocarbons, with special reference to natural gases, by adsorption and desorption from active carbon. The individual gases on desorption are characterized by measurements of their thermal conductivities, the apparatus being calibrated for this purpose with a reference gas. Since air has a thermal conductivity intermediate between that of methane and the higher hydrocarbons, it may be used with advantage for this purpose. An electrical circuit for the measurement of the conductivity is described, the deflection of a galvanometer being proportional to the conductivity. Since only comparative readings are required, it is arranged that the galvanometer shall read zero when the apparatus is filled with the reference gas, and the analysis is followed by plotting millivolts against the volumes of gas evolved.

Typical analysis data are given showing good separation of helium, nitrogen, carbon dioxide, and paraffins from methane to the butanes. *iso*Butane is separated from *n*-butane, but the division is not very sharp; olefines cannot be separated from the analogous paraffins with the exception of ethylene from ethane. This, however, is not important, as the fractions containing paraffins and olefines with the same number of carbon atoms can be analysed in the normal way with bromine water.

The author stresses the advantages of this method compared with fractional distillation, both as regards time taken for the analysis, the purity of the fractions obtained, and the ease of manipulation. T. T. D.

503. Ultra-violet Absorption as a Basis of a New Method for the Estimation of Aromatics in Fuels and Lubricating Oils. F. Jactes. *Oel u. Kohle*, 1938, **14**, 1012–1033.—Investigations of the composition of petroleums are concerned in general with the quantities of paraffins, naphthenes, olefines, and aromatics present, as determination of the individual compounds is impracticable, if not impossible. Even so, this analysis into groups is applicable only to gasolines, and depends on the varying reactivity of the different types towards sulphuric acid. Since there is no sharp differentiation between the reactivity of the different classes, methods based on this separation are bound to involve the introduction of errors, to which must be added those due to solution of products of reaction in the gasoline layer. The error involved varies enormously with the concentration of the acid and the conditions of the reaction and even when the same method is used on gasolines of different types and origins.

It is suggested that the measurement of ultra-violet absorption may solve this problem. Extensive work on the relationship between ultra-violet absorption and the constitution of benzene homologues shows that it is possible to make a quantitative estimation of the aromatics in gasoline by means of ultra-violet absorption. The extinction coefficients at 2600–2700 Å.U. of all aromatics boiling below 200° C. at atmospheric pressure that are likely to occur in gasoline have been measured, and from these values have been calculated mean extinction coefficients applicable to the aromatics in the whole gasoline fraction, and to those boiling up to 95° C., 95–122° C., 122–150° C., and 150–200° C. Hence, by measuring the absorption of the gasoline at 2,600–2,700 Å.U., the aromatic content can be calculated in moles per litre, and by the use of mean mol. wt. and mean sp. gr. be converted into volume percentages.

From a critical examination of the accuracy of the method an error of not more

than ± 10% of the amount found should be expected, but experimental work has shown that the actual error is usually less than ± 5%.

This quantitative estimation of aromatics is confined to the gasoline range. With increasing boiling point the number of possible aromatics increases rapidly, as does also the number actually present in petroleum. Further, the position and intensities of the maxima are more varied as a result of the presence of derivatives not only of benzene, but also of naphthalene and other condensed ring systems.

Work on a large number of commercial and synthetic lubricating oils shows that, without knowledge of the absorption curves of variously substituted polynuclear compounds, the absorption of lubricating oils cannot be quantitatively interpreted, and only a suggestion of the constitution and amount of the aromatic constituents can be obtained.

More work on this subject is of great importance, especially as the ring analysis method of Vlugter, Waterman, and Van Westen—at present the only other method available for giving an indication of the aromatic content of lubricating oil—gives values which are not more than of the right order of magnitude, and fails in limiting cases. T. T. D.

504. Viscosity and Lubrication. G. Vogelpohl. *Oel u. Kohle*, 1938, **14**, 991–997.—In laboratory measurements of the viscosity of oil in bulk, the temperature can be controlled to 0·01° C. by the use of a thermostat; in the case of viscosity measurements on thin films of oil, great difficulty is encountered in estimating the temperature, which may vary throughout the film. In this paper a mass of work on the subject is critically reviewed under the headings: methods of measuring temperature; results from these measurements; calculation of mean values; temperature fluctuation across the film; methods of estimating the actual temperature.

The questions dealt with are directly connected with the problem of "oiliness," which is dependent on the assumption of "uniform viscosity" in the bearing. As a result of work on the measurement of the actual temperature of the oil film, it is suggested that in those experiments the results of which led to the conception of oiliness, etc., the viscosity was not uniform throughout. T. T. D.

505. Determination of Sulphur in Light Refined Petroleum Oils. W. A. Schulze, V. W. Wilson, and A. E. Buell. *Oil Gas J.*, 23.3.39, **37** (45), 76.—Modifications of the Ethyl Corporation method for determination of total sulphur content by the lamp method are described. It has been found that in the presence of air, at the ordinary temperatures realized during the combustion of gasoline in air, some nitrogen is oxidized, resulting in formation of nitric acid, which reacts with the carbonate absorber solution, thus giving incorrect results for sulphur content of the gasoline. The amount of nitrate found in the absorber solution varies from one analysis to another owing to variation in flame temperature. The use of air or commercial oxygen (which normally contains 0·25–0·5% N_2) is therefore substituted by a carbon dioxide–oxygen atmosphere, using 27–30% vol. of commercial welders' oxygen and 73–70% vol. of dry CO_2 gas. This method also has the advantage of eliminating the usual air-purifying tube. Results of tests carried out comparing results by the air method, corrected for nitrate formation, and by the CO_2–O_2 method are tabulated, and show good agreement. Should the product tested contain nitrogen compounds, then nitrate determinations must be made on the samples after titration, since a portion of the nitrogen present is oxidized. Six tests carried out on a fuel of 0·182 sulphur content gave a maximum deviation of 0·001% in results. A description and illustrations of various parts of the apparatus and assembly are provided. Lamps of 5 ml. capacity are provided for oils of high sulphur content and lamps of 30 ml. capacity for oils of low sulphur content. The reagents employed are sodium carbonate solution of 0·05*N*, hydrochloric or sulphuric acid of 0·05*N* and methyl-orange solution 0·2 gm. in 100 ml. of distilled water. 10 ml. of acid must neutralize exactly 10 ml. of carbonate solution. Procedure for cleaning absorbers, adjustment of pressure, burning of sample, and removal of carbonate solution from absorber is fully described. In titrating, a reference blank is prepared by pipetting 10 ml. of carbonate solution into a clean flask, diluting to same volume as test samples, adding two drops of methyl-orange indicator and neutralizing the sample. The test sample is titrated with acid

until the solution colour matches the reference blank. Two drops of acid are then added to the reference blank. The amount of acid added to the test sample to match the altered shade of the reference blank is estimated to the fraction of a drop. The shade of the acidified blank is easier to match than the neutral sample, and a correction can be made to the neutralization value of the test sample. Duplicate determinations should not differ by more than 0·0005% if the sulphur content is under 0·03%, 0·001% if between 0·03 and 0·07, or 0·0015% if 0·07 and higher. R. A. E.

508. Accurate Fractionation of Hydrocarbon Blends. H. Brueckner. *Brennst. Chemie*, 1.1.39, **20** (1), 9, 10.—In a previous article (Abstr. No. 166, 1939) H. Macura and H. Grosse-Oetringhaus claimed that the method of accurate fractionation given by the author is unsuitable for engine benzoles containing less than 10% toluene.

The author presents test results with blends containing less than 10% toluene and shows that contents as low as 2% can be detected by his original method. Details of test procedure given in the article referred to are partly in agreement with the description given by the author several years ago, whilst no essential improvements have been suggested. L. R.

507. Laboratory Study of Condensate. W. F. Fulton. *Oil Gas J.*, 23.3.39, **37** (45), 104.—To ensure the representative nature of the samples of gas and liquid, the well is allowed to produce at the desired rate for a stabilization period of at least 24 hr. before sampling. The sampling period may extend over the following 24 hr., the gas flow being metered and the liquid production determined preferably in the separator. Liquid samples are taken under separator pressure by downward displacement of mercury, and gas samples are taken at separator pressure from taps located at the blow-off on the down-stream side of the separator. Containers and procedure used are described. A gas sample is analysed in a Podbielniak low-temperature fractionation apparatus for all hydrocarbons lighter than heptane; nitrogen is determined by interferometer in the methane fraction and CO_2 by absorption in KOH. A 50-c.c. cylinder of liquid is analysed and the volume, density and mol. wt. of the heptanes and heavier fraction are determined in order that the analysis can be reported in terms of mol. percentages. A high-pressure apparatus is described in which the gas from the separator can be compressed to the desired reservoir pressure, and the compressibility factor determined. Knowing the volume of the experimental recombination bomb and the pressure and temperature, it is possible to calculate the absolute amount of the gas, and to determine, from the liquid–gas ratio measured at the well, the volume of liquid sample to be introduced into the bomb. Correction factors applied and the method employed for introducing the correct amount of liquid are described. The construction of the experimental recombination bomb, which is fitted with an internal stirring motor directly connected to an agitator, is described and illustrated. Liquid and gas samples may be drawn from the container for analysis after equilibrium conditions have been reached. Making use of the amount of gas initially present in the bomb and the calculated density, mol. wt., and volume of the separator liquid introduced, the analyses of gas and liquid may be combined on a molal basis and compared with the analysis of the sample of the equilibrium gas phase from the bomb. R. A. E.

508. Viscosity Determination with the Road Tar Viscometer. H. Mallinson. *Asph. u. Teer*, 1939, **9**, 125–127.—A description is given of the Road Tar viscometer adopted by the Eighth Assembly of the International Permanent Association of Road Congresses. This apparatus, essentially the British Road Tar viscometer, with tubes having orifices of 10 and 4 mm. will be adopted by all member countries, and a brief description will be given in the specification D.I.N. 1995. The test temperatures recommended are 25°, 30°, and 40° C. The procedure of test is given, and it is hoped that other non-member countries will adopt the same apparatus and procedure.
H. L. W.

509. Mechanical Testing of Bituminous Road Surfacing Materials. E. Neumann. *Bitumen*, 1939, **9** (1), 1.—The author discusses the results of an investigation of the effect of various factors on the compression strength of sandasphalt, asphaltic con-

crete, and mastic asphalt, and makes proposals for the revision of the D.I.N. 1996 test for compression strength. It is suggested that a cylindrical specimen is more suitable than the cube of 7·09 cm. edge and can be more easily obtained from a road surface, a cylinder 8 cm. in height and 8 cm. dia. is therefore recommended. The specimen is prepared in a press instead of by tamping, test temperatures of 20 and 40° C. are proposed and rates of application of load of 20 mm./min. for sandasphalt and fine asphaltic concrete and 30 mm./min. for coarse asphaltic concrete are recommended. A. O.

See also Abstract No. 530.

Motor Fuels.

510. Action of Inhibitors on Polymer Gasoline. W. B. Ross and L. M. Henderson. *Oil Gas J.*, 23.3.39, **37** (45), 107.—Data are presented to show that the addition of small amounts of commercially available anti-oxidants to Gray-treated polymer distillates inhibits gum formation. Tests carried out on the gasolines included determination of the induction period by the oxygen-bomb test of the Ethyl Gasoline Corporation type and of the copper-dish gum content as determined by the Bureau of Mines method or by that described in Federal Specification VV-L-791a, method 330·1. These tests were carried out on a sample blend of equal parts of Pure Oil Co. polymer gasoline and straight-run gasoline to which varying amounts of inhibitors AO-3, AO-9, AO-14, U.O.P.-4, G-10 (solid) were added in quantities up to 45 lb. per 1,000 brl. of gasoline. The results are tabulated and plotted on curves, and are compared with results obtained by similar inhibitor additions made to ordinary unleaded doctor-treated Mid-Continent gasoline. The tables show that the susceptibility of the polymer blend to inhibitors is of the same general order as that of ordinary cracked gasoline. Other tests carried out with inhibited polymer blends to which varying amounts of T.E.L. had been added show that the effect of T.E.L. on the induction period was negligible, but the copper-dish gum content generally increased with increasing additions of T.E.L. up to 5 ml./gallon. Other tables and graphs show results obtained by addition of varying amounts of inhibitors U.O.P.-1 and U.O.P.-4 to six samples of polymer gasolines obtained by the U.O.P. catalytic process. The susceptibilities of these gasolines to inhibitors is of the same order as that of the polymer blend previously described. The properties of all the polymer gasolines and of the blend of Pure Oil Co. polymer and straight-run gasoline are shown. The octane ratings of the polymer gasolines were all between 80·5 and 83·0 A.S.T.M. motor method or L-3 method. Octane ratings carried out on blends with gasolines of lower octane rating show polymer gasoline to have a higher blending value than its actual rating. R. A. E.

511. Colouring of Petrol—Reasons Justifying the Practice. Anon. *Bol. Inform. Petroleras*, Nov. 1938, **15** (171), 107–109.—Note explaining the reasons why high octane number, anti-knock petrols are now coloured, by common consent in U.S.A., Great Britain, Germany, Canada, Uruguay, and other countries, to distinguish them from the low grade or third quality spirit, which is colourless. This practice has now been adopted in the Argentine Republic as well. H. I. L.

512. Patents on Motor Spirit. N. V. de Bataafsche Petr. Mij. E.P. 499,978, 1.2.39. Appl. 8.9.37. Removals of mercaptans from petroleum distillates by extraction with the aid of an alkaline-reacting substance. The reaction is carried out with a ternary sulphonium base dissolved in water or in a non-acid organic solvent which is totally immiscible in water and substantially immiscible with the liquid hydrocarbon mixture.

Standard Oil Development Co. E.P. 500,380, 8.2.39. Appl. 4.10.37. Desulphurizing gasolines consisting of a considerable quantity of olefines by mixing with H_2SO_4 (45–75% concentration), at an elevated temperature and under sufficient pressure to prevent vaporization of the gasoline. The mixture is separated into an extract and a raffinate phase and the gasoline recovered from the extract phase. The raffinate is passed over a dehydrogenation and desulphurization catalyst at 800–1100° F. and gasoline of improved octane number is recovered from the product.

N. V. International Hydrogeneerings-Octrooien' Mij. E.P. 500,859, 16.2.39. Appl. 31.8.38. Production of non-knocking benzines by treating unstable benzines (boiling below 260° C. and at least for the most part above 130° C.), in the vapour phase with H_2 in the presence of catalysts, and separating from the final product a safety fuel of high anti-knock stability boiling within 130–260° C.

J. M. Whiteley. U.S.P. 2,146,039, 7.2.39. Appl. 29.11.35. Improving the octane number of motor fuel containing paraffinic and non-paraffinic hydrocarbons by separating the fuel into light and heavy naphtha fractions; the heavy fraction is treated with a selective solvent and the paraffinic raffinate is passed over a dehydrogenating catalyst and the product blended with the light naphtha to produce the desired motor fuel.

T. W. Rosebaugh. U.S.P. 2,146,353, 7.2.39. Appl. 13.4.36. Desulphurizing hydrocarbons containing sulphur in the form of carbonyl sulphide by circulating a stream of the substance through an anhydrous alcoholic alkaline hydroxide solution under conditions to form H_2S, and then further treating with aqueous alkaline hydroxide to remove the H_2S.

O. S. Pokorny. U.S.P. 2,146,650, 7.2.39. Appl. 11.1.34. Refining oils of the naphtha and burning oil range by agitating them with tricresylphosphate, and, in the case of lubricating oils, with mixtures of esters, are used, and an aliphatic alcohol, acetone, phenol, cresol, etc.

R. E. Burk and E. C. Hughes. U.S.P. 2,148,056, 21.2.39. Appl. 9.3.36. Desulphurizing petroleum distillates in several stages with a sulphur-removing media, *e.g.*, caustic soda solution.

G. H. von Fuchs and L. E. Border. U.S.P. 2,149,035, 28.2.39. Appl. 19.2.37. Removal of mercaptans from hydrocarbon liquids by treating them in the liquid state at temperatures below 200° F. with metallic copper in the presence of a small amount of SO_2 in the absence of H_2SO_4. W. S. E. C.

Gas, Diesel and Fuel Oils.

513. Requirements of Present-day Diesel Fuels. R. Heinze and M. Marder. *Oel u. Kohle*, 1938, **14**, 832–843.—The increasing importance of diesel engines is illustrated by statistics dealing with the consumption of diesel fuels of various origins in Germany from 1931 to 1937. American (A.S.T.M.), British (B.S.I.), and German specifications for the various classes of diesel fuel are quoted and methods compared under the following headings: (1) Requirements as to Purity, Flash Point and Calorific Value; (2) Coke Number and Hard Asphalt; (3) Corrosive Properties; (4) Cold Test and Viscosity; (5) Ignition Properties (Cetane Number, etc.); (6) Stability on Storage and Miscibility. The individual tests are discussed at some length, particular attention being paid to the effects of differences in detail in the tests as performed in different countries, on the significance of the results obtained. T. T. D.

514. Miscibility and Storability of Diesel Fuels. O. Roelen. *Oel u. Kohle*, 1938, **14**, 1077–1079.—Diesel fuels derived from different sources have a widely differing content of, and solubility for, asphaltic material. The cyclic hydrocarbons obtained by dry distillation or hydrogenation of lignite and coal have a fairly high content of asphaltic bodies in solution. On the other hand, the synthetic diesel fuels have little solvent power for asphalt, whilst that obtained by the Fischer–Tropsch hydrogenation of carbon monoxide is purely aliphatic. It will thus be realized that storage of blends of fuels of different origin is bound to be difficult, and that a practical test that can be used to determine whether a fuel may be safely stored without deposition of asphalt, either alone or mixed with others, is essential.

The author reviews the work of Marder on this subject, and gives an account of the work carried out by the Ruhrchemie Aktien-Gesellschaft. As a result of more than 100 storage tests of mixtures of various fuels with a highly asphaltic fuel, diesel fuels were divided into three classes: (*a*) those which gave mixtures which remained clear indefinitely; (*b*) those which started precipitating after 3–9 months; (*c*) those

which gave a precipitate on mixing, whilst more came down on long standing. No class was found in which, if the precipitate formed on first mixing were filtered off, the filtrate remained clear on standing.

The author proposes the following as a test for the miscibility and storability of diesel fuels: to the fuel under test is added a fixed amount of precipitant; part of the mixture is allowed to stand for 24 hr. at room temperature in the dark; part is heated for 1 hr. to 180–200° C. under fixed atmospheric conditions. In evaluating the quality of the oil, the amount of precipitate in each case is taken into account. As precipitant is used a special highly aliphatic fuel, "RCH-Bezugdieselkraftstoff," of fixed physical and chemical properties; this fuel also has a very good cetane number, and may thus be used as a reference fuel in cetane number determinations.

T. T. D.

Lubricants and Lubrication.

515. Technical Control Required in the Manufacture of Greases. W. A. Lutz, H. A. Ambrose, and W. A. Gruse. *Oil Gas J.*, 9.2.39, **37** (39), 62; 16.2.39, **37** (40), 49.—The paper opens with a general survey of the applications of grease and the significance of the melting-point and other physical tests.

The authors state that attempts to set up a theory of grease consistency cannot be very successful without taking into account the nature of grease structure, and at present no generally accepted explanation of the latter exists.

The determination of consistency is discussed with special reference to the work of Bingham, Porter and Gruse, and Arveson. It is suggested that the rotary viscometer is a suitable instrument for investigating the apparent viscosities of soft greases. By carrying out determinations at temperatures on both sides of the approximate melting point, it may be possible to obtain a more accurate measure of the softening and melting points. At the present time, however, no method for studying flow and consistency properties of greases appears to be in a satisfactory state of development.

The separation of oil from grease is of considerable practical importance, and in this connection the work of Herschel and of Farrington and Humphreys is discussed. Chemical stability is also of great importance, and this is influenced by, among other things, the nature of the hydrocarbon oil present. It is well known that greases oxidize in storage and service, and various tests of oxidation stability have been devised, of which the best known are those due to McConville, and Wright and Lutz. The paper concludes with a criticism of the practice followed by many purchasers of buying greases to their own narrow specifications.

D. L. S.

516. Effect of Pressure on Lubricating Greases. B. B. Farrington and R. L. Humphreys. *Industr. Engng Chem.*, 1939, **31** (2), 230.—Ten compounded oil–soap greases were tested in a press designed by Herschel (*Proc. Amer. Soc. Test. Mater.*, **33**, Part I, 343). The variables studied were oil content, type of soap, time of pressing, pressure, and oil viscosity. It was found that the results could be correlated by the empirical equation

$$\frac{T}{L} = a + bT$$

where L = oil loss in weight per cent.
T = time in hours.
a, b = constants.

The ultimate oil loss is equal to $\frac{1}{b}$, whilst the constant a is found to be a qualitative measure of the bleeding of oil.

Increasing oil content increases rate of loss and ultimate loss. Increase of pressure has a similar effect. Decreasing the viscosity of the oil and keeping the content unchanged increases the rate of loss, but does not affect the ultimate loss. For the same grease consistency more oil can be pressed from sodium soap greases than from calcium or aluminium soap greases. The type of soap used is not the most important factor in bleeding.

P. D.

517. Effect of Fatty Acid Derivatives on Lubricants. A. W. Ralston and E. J. Hoffman. *Nat. Petrol. News*, 8.1.39, **31** (6), R. 50.—The addition of small quantities, up to 5%,

of alkyl-aryl ketones, $RCOR^1$, to low-viscosity petroleum lubricating oils reduces running friction and increases film strength. The mono- and di-chlorinated derivatives of these bodies also are useful addition agents. Xylylheptadecyl ketone was prepared by Friedel and Craft's reaction thus:

$$C_{17}H_{33}COCl + AlCl_3 \longrightarrow C_{17}H_{33}COCl\,AlCl_3$$
$$C_{17}H_{33}COCl\,AlCl_3 + C_8H_{10} \longrightarrow C_{17}H_{33}COC_8H_9AlCl_2 + HCl$$
$$C_{17}H_{33}COC_8H_9AlCl_2 + nH_2O = C_{17}H_{33}COC_8H_9 + AlCl_3 + nH_2O$$

The ketone is light coloured and miscible with spindle oil. Products of this type have flash points 415–460° F. and viscosities (S.U. 100° F.) 83–315 sec. Mixtures of monochloroxylylheptadecyl ketone and xylylheptadecyl ketone have excellent lubricating properties as judged by the data derived from dynamic tests. H. G.

518. Present Position of the Problem of the Lubrication of Engine Cylinders. C. A. Bouman. *Centre d'Etudes Thermiques, X^e Séance*, 16.12.38. *Chal. et Ind.*, Jan. 1939, **20** (225), 168.—The mechanical considerations are first considered, particularly the effect of the viscosity of the lubricating oil on fuel consumption. The temperature of cylinder and piston render fluid lubrication almost impossible. The deposits causing ring sticking are next discussed, and it is considered that this trouble is most serious in aero and diesel engines. Incomplete combustion of fuel (in which is included lubricating oil which finds its way into the combustion space) has been shown to cause ring sticking in diesel engines, and the possibility of overcoming this by increasing operating temperatures has been suggested. The methods of overcoming this trouble differ with I.C. and C.I. engines. In the first, the use of more stable, less volatile oils has helped, whilst in the latter, particularly with high-speed diesels, some success has attended the use of less stable oils which are capable of dissolving or dispersing the gummy products of incomplete combustion. A study of these deposits has led to attempts to differentiate between "soot" and "carbon." A more extensive examination has been undertaken by a collaborator, M. Th L-A van der Poel, by extraction with 70% alcohol instead of aromatic-free 60/80 spirit. Up to the present this method has not clarified the mechanism of oxidation of oil in the ring grooves. H. L. W.

519. Patents on Lubricating Oil. Standard Oil Development Co. E.P. 500,385, 8.2.39. Appl. 25.10.37. Lubricant consisting of a hydrocarbon lubricating-oil base and a sulphurized polymer of rapeseed or mustard-seed oil or a blended oil having the approximate properties or rapeseed oil.

A. P. Lowes and Imperial Chemical Industries Ltd. E.P. 500,979, 20.2.39. Appl. 20.8.37. Production of synthetic lubricating oils by the condensation of chlorinated long-chain aliphatic hydrocarbons with benzene or homologues in the presence of aluminium or anhydrous aluminium chloride. The condensation products are subjected, either during or after isolation from the reaction mixture, to a mild cracking operation.

E. W. Fawcett and Imperial Chemical Industries Ltd. E.P. 501,194, 20.2.39. Appl. 18.6.37. Stabilization of vegetable, animal, or fish oils and fats by adding an anti-oxidant obtained by high vacuum distillation of a triglyceride oil or fat containing natural anti-oxidants.

Standard Oil Co. and A. H. Stevens. E.P. 501,369, 27.2.39. Appl. 31.8.37. Refining of hydrocarbon oils and wax by subjecting the mixture at between + 5° and — 15° F. to the action of a mixture of liquid SO_2 and isopropyl ether.

W. H. Bahlke and F. W. Scheineman. U.S.P. 2,145,852, 7.2.39. Appl. 23.8.34. Refining heavy oil to form bright stocks by mixing the oil with propane in several stages, and fractionating the mixture at 250–650 lb./sq. in. at 110–200° F. in a high-pressure settling zone. The asphalt and propane–oil solution are separately withdrawn, and the pressure of the propane–oil solution is reduced. The solution is then acid-treated at a lower pressure than that used in the asphalt separation; the oil is neutralized and the propane removed.

P. C. Keith, Jr., and H. O. Forrest. U.S.P. 2,146,147, 7.2.39. Appl. 28.6.34. Lubricating-oil refining by counter-current extraction with a mixture of a naphthenic solvent and propane. After removing the propane from the extract, it is extracted counter-currently with the naphthenic solvent.

L. W. Cook and C. C. Towne. U.S.P. 2,147,573, 14.2.39. Appl. 27.11.37. Solvent dewaxing of hydrocarbon oils by means of a wax crystal modifying substance which is a reaction product of rubber in an aromatic solvent in the presence of glacial acetic acid and stannic chloride.

E. C. Knowles. U.S.P. 2,147,579, 14.2.39. Appl. 20.9.35. Dewaxing of hydrocarbon oils using a mixture of an aliphatic ether containing up to 8 carbon atoms, and methyl ethyl ketone. The latter is used in excess of 40% by vol. of the solvent mixture.

C. L. Read. U.S.P. 2,148,710, 28.2.39. Appl. 21.11.36. Process of increasing the yields of high-quality lubricating oils by extracting the lubricating fraction of petroleum with phenol, removing the extract phase and adding 5–10% of water and then propane in quantities of ½–4 vols. of propane to 1 vol. of extract–water mixture. After standing for some time, the bottom layer is discarded, and the upper layer, after removing the propane, is returned to the extraction tower.

J. M. Whiteley and G. A. Beiswenger. U.S.P. 2,148,716, 28.2.39. Appl. 23.5.32. Fractionation of heavy oil into several fractions by means of light hydrocarbons consisting principally of propane. W. S. E. C.

See Abstract No. 504.

Asphalt and Bitumen.

520. Bubble Formation in Mastic Asphalt. W. Neukom. *Asph. u. Teer*, 1939, **39** (5), 62–66.—A description is given of analyses undertaken on samples of road constructed with mastic asphalt of various types with a view to determining the reason for excessive bubble formation. Bubbles are formed owing to the action of heat on open spaces in the mastic asphalt which contain air and traces of water. It is stated that in order to reduce the possibility of bubble formation, the concrete formation should be dry and that an insulating medium such as absorbent paper, wrapping paper, or newspapers should be placed between the concrete and mastic. The type of bitumen used should be carefully selected, since it has been found that where bubbles occur, the bitumen extracted from the road sample shows a great degree of hardening, whereas when the bitumen properties are essentially the same as when laid, few bubbles are found. A sample taken from a satisfactory section of road showed a decrease in penetration of 38%, in ductility of 50%, and an increase in Ubbelohde drop point of only 11%. E. W. H.

521. Roughness and Grip Characteristics of Asphalt and Tar Roads. F. J. Nellensteyn. *Asph. u. Teer*, 1939, **39** (5), 66–68.—The article describes determination of the coefficient of friction on various stretches of road in Holland by means of a dynamometer road car using a partly braked wheel. It was found that the coefficient of friction of road surfaces varies with the actual hour of the day, *e.g.*, on the particular road tested the coefficient was highest at 2 a.m. and lowest at 2 p.m., the temperatures at all times being roughly inversely proportional to the coefficient.

The author points out that the construction of rough-surfaced roads, although excellent from the point of view of non-skid properties, is not always desirable in the interests of hygiene, and quotes an example of the use of pulverized rubber in the surface dressing whereby surface irregularities causing roughness were filled with rubber, giving a smooth surface without impairing cohesion. E. W. H.

522. Use of Bitumen for Road Construction in the United States. D. B. Miller. *Rev. Pétrolif.*, 1939 (828), 317–319.—The author gives a short summary of the history of the use of bitumen for road-making in America, and then briefly discusses liquid

asphalts—the most common type—which are divided into three grades: road oils, kerosine cutbacks, and naphtha cutbacks. Equally important in the U.S.A. is the employment of bituminous emulsions.

A table is given showing the methods of road construction and dressing suitable for roads of traffic density varying from 0 to 300 vehicles per day to 500 to 5000 vehicles per day, together with the approximate cost per mile for widths of from 18 to 20 ft., and the expected durability in years of each type of construction.

E. W. H.

523. Employment of Asphaltic Materials for Road-surfacing. W. S. Housel. *Rev. Pétrolif.*, 1939 (828), 320–321. Attention is directed to the marked development in the use of bituminous materials for road-surfacing in the United States during the past few years. The most recent progress is in connection with improvements to secondary roads such as those serving rural communities, carrying a comparatively small amount of traffic, the treatment of which is justified by the resulting economy of maintenance. Mention is also made of the greatly increased use of bituminous materials for car parks, aerodrome runways, etc., by earth-mix and soil-stability methods, and of problems connected with the action of bituminous materials on mineral aggregates.

E. W. H.

524. Uses of Emulsions. M. Duriez. *Rev. Pétrolif.*, 1939 (828), 322–329.—The uses and properties of emulsions for road-making together with standardized methods of testing, are described. Suitable types of emulsion for such purposes as surface-dressing, grouting, soil stabilization, etc., are given, together with descriptions of methods of application in each case.

E. W. H.

525. Preparation and Properties of Bitumen Emulsions. G. Radulesco. *Rev. Pétrolif.*, 1939 (828), 330–336.—It is stated that the consumption of bituminous emulsions in France is of the order of 500,000 tons per year. Rapid-breaking surface-dressing types are the most important and most difficult to control, since they must be stable in storage, break rapidly on the road, and have a viscosity sufficiently high to prevent them draining away on application.

The author finds that the different properties of the emulsions depend directly on the pH of the aqueous phase, and in particular refers to the degree of dispersion, which has a considerable influence on the properties of bituminous emulsions. The degree of dispersion is claimed to be most conveniently and quickly examined by determining the coefficient of extinction of green light by the suitably diluted emulsion in a colorimeter. The large particles which are present to varying extent in all emulsions tend to coalesce on shaking the emulsion, and if these are removed the emulsion remains free from large particles unless again agitated.

The interfacial tension, which can only be measured between dilute benzene solutions of the bitumen and aqueous buffer solutions, decreases to a minimum as the pH increases. The interfacial tension is lowered by the different emulsifying agents added, and thus the emulsibility of the bitumen is increased. This, in turn, can be shown to be increased as the band of stability increases on the pH scale. This band is obtained by plotting the mean diameter of the particles against the pH, generally from pH 10·5 to 12·5, and is widened by the addition of emulsifiers.

The viscosity of emulsions can be increased by additions of substances as gelatine, bentonite, etc., but these increase the stability, and are thus unsuitable for surface-dressing-type emulsions. Stearic acid has been found suitable, however, since the stability is not increased, but emulsions containing this acid are found to be markedly thixotropic. Better results have been obtained with the use of certain sulphonic acids, in which the increase in viscosity is due to inversion. The author points out that this method may lead to unsatisfactory results in practice.

Stability on storage depends on a large number of factors (pH, degree of dispersion, etc.), as does the rate of sedimentation.

The "rate of breaking" of the emulsion depends on the surface area with which it is in contact, the nature of this surface, whether it is hydrophobic or hydrophilic, on the kind and amount of the emulsifying agent, on the presence of salts, and particularly on the atmospheric conditions.

The bitumen used has a considerable effect on the different properties of the emulsions, and the author attributes this difference to the presence of different active bodies. H. G. W.

526. Main Roads of Montana. D. L. Cheney. *Rev. Pétrolif.*, 1939 (828), 337–341.—Owing to transport expenses, roads in Montana are limited to the use of local aggregates and cutbacks. The main roads are treated with premixed aggregate either on the road or at works, whilst for the secondary roads cheaper cutbacks are used and thickness of the course is reduced. Details of the premixing operations are given, the aggregate being heated to 120° C. at the works and the calculated amounts of preheated cutback added. This type of road is laid only where conditions are severe, otherwise mixing is carried out on the site. Tentative specifications are given for the rapid, medium, and slow curing cutbacks used, these specifications being similar to those of the American Asphalt Institute; the rapid curing cutbacks are used for the best roads. A method of procedure in Road Mix construction is described, giving details of the procedure used for the main and secondary roads, and of the preliminary treatment before laying. All roads are seal-coated 10–21 days after laying, using rapid-curing cutback. It is claimed that Montana has thus obtained at reasonable cost over 10,000 kilometres of good-class level roads with long life and freedom from dust. H. G. W.

527. Effect of Addition of Bitumen on the Properties of Cement Mortar and Concrete. R. Grün and H. Schlegel. *Bitumen*, 1939, **9** (2), 25–31.—An investigation has been made of the effect of addition of up to 10% of bitumen, in emulsified form, on the ductility, beam test, shrinkage, and water resistance of mortar and concrete. Four brands of emulsion were used with Portland and blast-furnace cements, and in most cases tests were made on specimens stored in air for periods up to 28 days, and on specimens stored in water for 28 days; the shrinkage tests were made on specimens stored for 120–140 days. The results showed that the effect on the setting time differs with different cements and emulsions. The mortar strength was decreased to varying extents, but was still satisfactory. Water resistance was improved, whilst shrinkage increased with Portland cement and decreased with blast-furnace cement. In the case of concrete the strength was only slightly affected with a wet mix, and not at all with a plastic mix, whilst shrinkage was decreased in both cases. A. O.

528. Tar Chippings and Water. H. Mallinson and H. Schmidt. *Asph. u. Teer*, 1939, **4**, 51–54; **5**, 59–62; **6**, 75–79; **7**, 91–94.—The paper describes an investigation which was undertaken in an attempt to determine the factors affecting the resistance to stripping of tar coatings from chippings, on immersion in water.

100 gm. of warm chippings were mixed with 3·5 gm. of tar at 80° C. until completely coated, the chippings were stored in a closed box for a given time at room temperature and then covered with water; alternatively, the chippings were stored in the box for ½ hr. at 50° C. and then covered with warm water, the extent and time of stripping being noted.

No relation was found between content of phenols or bases and resistance to stripping, and although addition of these materials to tars resulted in increased stripping, it is pointed out that the amounts present in road tars are very small. The addition to tar of 0·5% of Montan wax or 2% of brown coal tar improved resistance to stripping, but oil or pitch from the latter, paraffin wax, soaps, stearic acid, stearine pitch, Montan wax pitch, rosin, and Irga chemicals had no effect. A tar containing 15% asphaltic bitumen also showed no improvement over a tar from the same source and of similar viscosity to the mixture. Emulsification of a tar with a small amount of water gave a slight improvement, and addition of 1% anthracene to a tar which was easily stripped gave complete resistance to stripping.

The effect of setting time of the tar on the resistance to stripping was examined, but no definite relationship found; similarly no relationship was found between resistance to stripping and micron content or benzole insoluble content of tar.

It is pointed out that the differences in properties of aggregates are far greater than between tars. Tests with a series of stones with tars of good, poor, and intermediate resistance to stripping showed no differences between the stones with

either of the first two tars; the intermediate tar, however, showed marked differences. Siliceous and quartz aggregates had good resistance to stripping, basic and water-soluble stones poor resistance, and weathered stone, such as mica, orthoclase, and plagioclase, intermediate resistance. Tests with glass showed that resistance to stripping was improved by water extraction of alkaline constituents.

Differences were found in limestones from different sources, and this is attributed to porosity, nature and size of crystal formation and carbonate content.

Resistance to stripping increased with increasing time of storage; this is thought to be due to penetration of tar into pores in the stone, since viscosity increase was not possible in the closed box. The adverse effect of increased temperature of the water is believed to be due to reduction of viscosity and breakdown of structure in the tar film. Tests with distilled and tap water and various solutions indicated that resistance to stripping could be graded according to concentration of sodium carbonate, but it is pointed out that this classification has little practical value; calcium hydroxide and carbonate generally gave similar results to water.

The authors conclude that viscosity, setting properties, and the presence in the tar or on the stone surface of material which will result in the building up of a structure in the tar film all have an influence on the resistance to stripping of the tar by water; the presence in or on the stone of water-soluble materials or materials which swell in water has an adverse effect. It is pointed out that the behaviour of materials in the laboratory stripping test may not necessarily indicate the suitability of the materials for use in road construction, and results should be considered in conjunction with the practical experience with similar materials. A. O.

529. Patent on Asphalt. E. B. McConnell. U.S.P. 2,148,869, 28.2.39. Appl. 30.10.36. Production of asphalt by heating petroleum residuum to 400–550° F. and air-blowing, and introducing while air-blowing and, without substantial cooling, a small amount of catalyst—*e.g.*, oxides of nitrogen, chlorine, or a sulphur-containing substance. W. S. E. C.

See also Abstract No. 509.

Special Products.

530. Photo-oxidation of *iso*Propyl Ether. G. Radulesco. *Ann. Off. Combust. liq.*, 1938 (6), 1071–1082.—*iso*Propyl ether is oxidized in the presence of light, giving acetone, water, acids, peroxides, and resinous products. The proportion of these products formed varies with the volume of oxygen absorbed. Methods are given for estimating the percentage of acetone, water, and gum formed by oxidation, and the actual changes are brought about by immersing bulbs containing *iso*propyl ether and oxygen in a constant-temperature water-bath at 16° C. at a distance of 13 cm. from the filament of a 500-watt lamp. Absorption of oxygen is measured with a mercury manometer.

Under these conditions it was found that 0·1% of *p*-cresol, *p*-aminophenol, or *p*-phenylenediamine retards oxidation of *iso*propyl ether, and hence the formation of oxidation products, *p*-phenylenediamine being the most efficient. On the other hand, α-naphthol, which is a good oxidation inhibitor for cracked gasoline, actually assists oxidation of *iso*propyl ether under the conditions specified. E. W. H.

531. Insulating Oils. Shell Technical Service. *Olii Min.*, 1939, **1**, 1–6; **2**, 17–22.—It is stated that prior to the development of methods of refining mineral oils, rosin oil was used for transformers and switches, but these oils did not give satisfactory results owing to formation of polymerization products, appreciable acidity increase, high evaporation loss, and tendency to thicken at high temperatures.

With the progress made in mineral-oil refining, mineral oils were adopted, although they also suffer to some extent from the same disadvantages.

The factors most affecting the quality and life of a transformer oil are: high temperatures, oxidizing action of the air, and contact with a metallic surface; copper in particular has an adverse effect on the oil, the effect being more pronounced with a polished surface. In presence of acidic compounds insoluble soaps are formed with lead, and the acidity of the oil does not increase.

The injurious action of sludge in the oil is pointed out: sludge settles and collects on insulators, forming brittle oxycellulose with materials composed of cellulose.

The influence of light on the stability of the oil has been studied by observing the action of the individual solar spectrum rays; the red rays have the least effect.

The various refining processes are outlined, and the superiority of solvent extraction over the usual sulphuric acid treatment is pointed out.

The selection of the crude oil is also of great importance, since not all crudes yield distillates suitable for transformer-oil manufacture; naphthenic base crudes have been found especially suited for the purpose.

Concerning the methods of testing adopted in various countries, no definite agreement has been as yet attained, nor has the reproduction of the complex reactions occurring during use yet been achieved. The various procedures for estimation of the resistance of the oil to oxidation and high temperatures are substantially the same, and consist in subjecting, for a given time, a definite amount of oil to the action of heat and air either in presence or not of a catalyst. The alteration of the oil is shown by the increase in acidity and percentage of deposit. The data thus obtained by any one method have a purely comparative value. Other tests applied to this type of oil of particular importance are: flash point (P.M.), viscosity, dielectric strength. The latter property is not related to the physico-chemical characteristics, but depends on the purity of the oil; traces of moisture or dust may impair dielectric strength appreciably.

Finally the switch oils are mentioned; although the conditions under which these are employed are different from those of transformer oils, the same characteristics are requested. P. G.

532. Agricultural Products as Insecticides. R. C. Roark. *Industr. Engng Chem.*, 1939, **31** (2), 168–171.—A review of insecticides and fungicides at present in use in the U.S.A. is presented. Although the materials used are mainly derived from the mineral kingdom, products from the vegetable kingdom are increasing in importance, in virtue of the fact that while many organic compounds are more toxic to insects, they are usually far less toxic to man than lead arsenate and other similar inorganic poisons.

The naturally occurring insecticides obtained from plants—*e.g.*, nicotine, pyrethrin, rotenone, etc.—are quoted, together with the pine-tar oils and similar materials obtained from trees of the coniferous type. Indications are, however, that the insecticides of the future will be organic compounds synthesized from products of plant origin. H. C. R.

533. Permeability of Neoprene to Gases. T. P. Sager and M. Sucher. *Bur. Stand. J. Res. Wash.*, 1939, **22**, 71–79.—The permeability of neoprene in the form of (*a*) unsupported films and (*b*) coated fabrics, to various gases has been examined and compared with that of rubber. It was shown that the rate of permeation is inversely proportional to the thickness of the film.

The specific permeability of unsupported films to hydrogen, helium, and carbon dioxide at 25° C. was shown to be about $\frac{1}{3}$–$\frac{1}{6}$ that of rubber. The effect of temperature was investigated in the case of hydrogen, and the increase in the rate of permeability with temperature found to be exponential.

In the case of coated fabrics, the cloth makes a definite contribution to the gas impedance. Moderate amounts of the usual compounding ingredients do not appreciably affect rate of permeation. However, the use of highly volatile solvents in spreading the compounded neoprene tends to produce pinholes.

Toluol or its equivalent appears to be the most satisfactory solvent. D. L. S.

534. Use of Paraffin Wax in Pyrotesting. F. Taradoire. *IIme Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 63–65.—Wax which is intended for use in conjunction with explosives must be free from acidity, fatty matter, and finely divided mineral matter. Inspection tests are described. In order to prevent autoxidation of wax, the addition of anti-oxidants (*e.g.*, hydroquinone) is recommended. P. G. H.

535. Patents on Special Products. E. I. Du Pont de Nemours and Co. E.P. 499,770, 27.1.39. Appl. 27.7.37. Production of boron fluoride by treating anhydrous HF and a compound from the group boric acid, boric anhydride and a borate, and treating the resultant product with calcium fluoride.

B. Collie, S. Ellingworth, A. Robertson, and Imperial Chemical Industries Ltd. E.P. 500,197, 30.1.39. Appl. 30.6.37.—Preparation of an insecticide comprising benzthioazyl-2-ethyl sulphide or 5-chlorobenzthiazyl-2-ethyl sulphide, etc., mixed with an inert pulverulent diluent or carrier—*e.g.*, chalk, kieselguhr, or bentonite—to which is added, if desired, a water-absorbent or dust-binding agent such as wool fat. The carrier may be dissolved, suspended, or emulsified in water or a suitable organic liquid which is immiscible with water—*e.g.*, mineral oil.

Standard Oil Development Co. E.P. 500,377, 8.2.39. Appl. 13.9.37. Production of a modified alkyd resin by reacting a polyhydric alcohol containing more than 2 OH groups with not more than 1 mol. of a naphthenic acid derived from petroleum until such partial esterification is substantially complete, and then reacting the resultant compound with a polybasic acid until the esterification is completed.

G. W. Johnson. E.P. 500,382, 8.2.39. Appl. 20.10.37. Production of olefine oxides by the catalytic oxidation of low-mol.-wt. olefines with O_3 or gases containing O_3 in the presence of Ag salts. The latter are prepared by the reduction of solutions or suspensions of Ag compounds in the presence of Cu or Au compounds.

G. W. Johnson. E.P. 500,745, 15.2.39. Appl. 13.9.37. Refining of synthetic methanol by means of chromic acid.

E. H. Strange and T. Kane. E.P. 500,880, 16.2.39. Appl. 16.8.37. Manufacture of alkyl chlorides by treating olefines with hydrogen chloride in the presence of prepared bauxite, at 150–300° C. at atm. pressure.

G. W. Johnson. E.P. 501,015, 16.2.39. Appl. 16.8.37. Conversion of compounds containing triple carbon linkages into those containing double carbon linkages by treating C_2H_2 or its non-metallic organic derivatives (containing triple carbon linkages) in an aqueous alkaline solution with metallic Zn.

G. W. Johnson. E.P. 501,071, 21.2.39. Appl. 1.9.37. Manufacture of butadiene from butylene using a solid catalyst.

W. H. Carmody. U.S.P. 2,149,275, 7.3.39. Appl. 23.9.37. Production of resins from acid sludge and pure still residues resultant respectively from the acid-washing and fractionation of light oils produced in the by-product coking of coal.

W. H. Carmody. U.S.P. 2,149,577, 7.3.39. Appl. 17.6.36. Production of an aromatic-solvent oil from distillate oil obtained from still residues. W. S. E. C.

Detonation and Engines.

536. Recent Aero-Engine Research Work. H. C. Mansell. *Aircr. Engng*, March 1939, **11** (121), 92–94.—A survey is made of the major phases of research which have led to the present position of the aero-engine as regards improved performance and reliability.

Increases of approximately 100% in the specific output of engines during the past ten years, due almost equally to increased piston speed and mean effective pressure, the latter secured largely by advanced anti-knock qualities of fuel, have imposed special demands on valve gear, piston, and bearing capacity. Reliability of valve gear has been vastly improved in the case of poppet-valve engines, mainly through metallurgic research in connection with valve steel, but the author considers that piston and bearing problems are still at the present time in large measure the focus of engine research. The tin-base white-metal, hardened with antimony, has given way to the general use of copper–lead mixtures, cadmium base alloys, and practically pure silver as bearing metals, whilst, as a result of intensive research still proceeding in the field of the lubricating medium, considerable advance has been made in corrosion inhibitors, film strength, and anti-ring gumming additives.

Study of the factors which control detonation has led to the evolution, in both liquid- and air-cooled engines, of greatly improved methods of cylinder cooling and promoted research into the improvement of supercharger efficiency with a view to reducing mixture temperature, which, apart from the fuel, is the most important feature governing detonation point. As an example of the combined effect of fuel anti-knock qualities and blower efficiency it is stated that, under economy conditions, one octane number is equivalent to about 3° C. mixture temperature change or 3 lb./sq. in. mean effective pressure alteration.

Reliability, durability, and freedom from servicing have been steadily improved due to research into fundamental engine problems and the design of certain items of the equipment. The ignition system, for example, has undergone considerable review to meet the demands of increased engine duty and prolongation of periods between attention; in this connection spark-plug life has been extended by the adoption of a fine wire, precious-metal electrode system, and vastly improved insulation material, together with series resistors or condensers which greatly decrease the spark-point erosion rate.

In a brief indication of possible developments and needs of the future, the author refers to the advantages of high altitude or "sub-stratospheric" operation and possible means of meeting the demands thereby imposed upon blower design and operation. The growing claims of the C.I. engine are also considered, as are too the advantages offered by the substitution of the direct-petrol-injection system for the carburettor. Complete immunity from engine freezing problems, reduced fire risk, increased reliability of control, and perfect distribution are said to be the chief claims for this system. E. F. C.

537. Development of Liquid Cooling. W. N. Twelvetrees. *Aircr. Engng*, March 1939, **11** (121), 107–110.—Following illustrations of early cooling systems in which inherent defects are shown, the paper describes a typical glycol-cooled installation for a 12-cylinder V engine incorporating thermostatic control and dual radiators. The important effect of coolant temperature on cylinder liner joints is discussed and the advantages gained by the use of thermostats in controlling this variable in actual flight conditions are shown. The paper concludes with a description of the method of operation of "pressure cooling" which represents the latest stage of development. In principle, the system consists of the normal installation layout, but, instead of glycol alone, the coolant is a mixture of water with 30% glycol, whilst the positive pressure relief is usually about 30 lb./sq. in. instead of 3 lb./sq. in. Advantage is taken of the high specific heat of water, whilst ebullition in flight is avoided. In addition, the superior specific heat of the coolant mixture over that of glycol alone permits of a reduction in radiator size of 20%. E. F. C.

538. Valve and Valve Seat Technique for Automobile and Aero Engines. F. R. Banks. *J. Instn Aut. Engrs*, 1938, **7** (3), 32–63.—This article reviews the causes of poor valve and valve-seat performance in automobile and aero engines, and gives examples of good and bad valve and port design. Specifications of the principal steels now being successfully employed, and details of many types of valve insert designs, are shown. Increasing interest is now being shown in the materials used for valve guides, and it is suggested that unalloyed cast iron, which is in general use in this country in automobile practice, may be superseded by nickel/chrome iron alloys. Experiments have shown that for every 0·001 in. increase in initial clearance between valve stem and guide, the wear in 10,000 miles running increased by 0·002 in. More serious attention is now being given to the finish of guides, valves, and seats. New types of silchrome steel are now being introduced which give much better results than the Silchrome No. 1, which has proved successful over a long period. Some details of results obtained with the new "Brightray" alloy of nickel and chromium for treatment of valves and inserts are given. This material is claimed to improve the resistance to wear, oxidation, and corrosion. Results now obtained in aero-engine practice show what can be achieved when cost is not of primary importance, and considerable data are given dealing with aero-engine valves and inserts. Regarding the use of leaded fuels, the author contends that many troubles attributed to lead have been due primarily to the increased power permitted

by such fuel. It is true that leaded fuels are not so tolerant of poor design, inferior valve material, and poor seating. Engines do not now suffer as they used to do from these defects, and almost universal use of leaded fuels should provide adequate answer to queries regarding their value. C. H. S.

539. Supercharging of Compression-Ignition Engines. J. H. Pitchford. *J. Instn Aut. Engrs*, 1938, **7** (3), 64–94.—This paper reviews the behaviour of the smaller size of high-speed four-cycle engine under pressure-charged conditions. Under pressure-charged conditions the C.I. engine has one practical advantage over its petrol counterpart, as with the former air only is dealt with up to the moment of fuel injection, and the phenomena of pre-ignition and detonation do not exist. Unless the structure of the engine is very materially increased, injection timing must be adjusted to maintain substantially constant maximum pressures, which entails some sacrifice in the response to supercharge. It has been found in the case of a separately driven blower that the fuel consumption at loads below the smoke point is reduced by an amount corresponding to the work done by the supercharger on the engine piston during the suction stroke. The author contends that the reason for increased fuel consumption of road vehicles which are supercharged is mainly due to the fact that the greater power available is fully used in acceleration and in maintaining a higher road speed.

The alternatives to supercharging are enumerated. Objections to these alternatives lead the author to the conclusion that supercharging is the best solution to the increased power problem, since a relatively large increase in nett output may be realized without appreciably increasing the severity of the temperature conditions of the piston and rings, which must be regarded at present as the "bottle neck" in increasing specific engine output.

The influence of supercharging on general design is dealt with at length, and details of the popular types of supercharger are given, with their respective advantages and disadvantages. Experiments with induced intake rams lead to the conclusion that much more might be done by this means to increase power output. Data are given on the practical application of supercharging of C.I. engines dealing specifically with the use of a "Centric" supercharger, and details of cost are given relating to the production of engines of varying capacity. C. H. S.

540. Preliminary Chemical Reactions in a Gasoline Engine. L. A. Peletier, S. G. Van Hoogstraten, J. Smittenberg, and P. L. Kooyman. *Centre d'Etudes Thermiques, X^e Séance*, 16.12.38. *Chal. et Ind.*, Jan. 1939, **20** (225), 120.—During some research work on a C.F.R. engine into the effect of mixture strength on compression pressure, it was observed that measured values did not agree with those expected from calculation. This fact was confirmed by means of an optical indicator; a quartz window in the combustion chamber revealed a blue luminescence whilst running with the ignition switched off, thus establishing the existence of chemical reactions.

A C.F.R. engine was driven by an electric motor at 900 r.p.m., with an air-intake temperature of 150° C. and a compression ratio of 5·75 : 1, the ignition being switched off. As the mixture was progressively enriched, the expansion curve on the indicator diagram became flatter, and the torque required to motor the engine decreased. Minimum torque was recorded with a mixture 80% rich, under which conditions auto-ignition took place about 60° after top dead centre. The occurrence of these phenomena was suppressed by the addition of tetra-ethyl lead.

A small two-stroke motor-cycle engine was used for further tests, in which the exhaust gases were collected and analysed. The cylinder-head temperature was slowly raised whilst the engine was motored at 1500 r.p.m. At first the exhaust gas temperature rose in proportion to the head temperature, but when the latter reached 240° C. a sharp break occurred, accompanied by auto-ignition. Further heating of the head resulted in the formation of peroxides in the exhaust gas; a second zone of auto-ignition was manifest at 500° C. The results confirmed the conclusions of other observers, that considerable quantities of peroxides can be formed during the compression stroke, and that they have an important influence on the occurrence of detonation.

Similar effects were produced by means of a quartz tube in which hydrocarbon

vapours and air were allowed to meet at elevated temperatures, these being again accompanied by the occurrence of an exothermic oxidation process. It is believed that the phenomena studied in the two engines and the quartz tube are identical.

K. T. A.

See also Abstract No. 518.

Coal and Shale.

541. "Dust-proofing" of Coal. Anon. *Report of Fuel Res. Board for Year ending* 31.3.38, 89–96.—The effect of the porosity of coal on dust-proofing has been investigated, since it is considered probable that porosity largely determines the relative proportion of oil required for treating various coals.

To prevent penetration of the dust-proofing liquid some experiments in blocking the entrance to the pores have been tried out. The greatest success has been achieved with (*a*) 1–2% raw rubber or (*b*) an *iso*butylene polymer in a mineral oil. The equipment for spraying coal is described and two different types of nozzle have been used: (*a*) air operated—the fluid being atomized by air, (*b*) pressure operated—in which the oil at high pressure is forced through a fine orifice.

Dust-proofing appears to have little effect on the combustion properties of coal, but there is some slight evidence that size degradation is less with well-sprayed coals.

D. L. S.

542. Treatment of Tar and Oils. Anon. *Report of Fuel Res. Board for Year ending* 31.3.38, 147–186.—The study of the treatment of tar has been mainly confined to the investigation of the hydrogenation process. This in general takes place in two stages :—

(1) Liquid-phase treatment in presence of a finely dispersed catalyst to convert asphaltic material into oil.

(2) Hydrogenation in vapour phase of selected fractions from the first treatment over a fixed catalyst to yield the required product.

The liquid-phase hydrogenation of both high- and low-temperature tar takes place readily in the presence of hydriodic acid or a mixture of this acid with ammonium molybdate.

For the vapour phase treatment a fixed catalyst is used consisting of :—

(*a*) A supported material such as molybdenum sulphide on alumina gel, or

(*b*) A pelleted material such as pure molybdenum or tungsten disulphides.

(*a*) can be readily reactivated but (*b*) must be entirely re-made when its activity has deteriorated.

Results obtained by treatment of low-temperature Cannel tar and Kimmeridge shale tar are given.

Experiments have been carried out on the desulphurization of benzole by mild hydrogenation. Three catalysts were tried out :—

(1) Molybdenum sulphide on alumina gel.

(2) A mixture in equimolecular proportions of MgO, ZnO and MoO_3.

(3) Pelleted molybdenum disulphide.

Catalyst (1) showed the least loss in activity, but none of the catalysts effected a sufficient reduction in S. Catalyst (3) was found to be the most suitable substance for work at elevated pressures.

Diesel fuels have been prepared from low-temperature tars, Cannel tar, and shale tar by :—

(*a*) Direct distillation.

(*b*) Hydrogenation over suitable catalysts.

The two latter tars yield oils with good cetene numbers.

A number of pure substances have been treated by the hydrogenation-cracking process in order to study the nature of the reactions occurring during hydrogenation.

D. L. S.

543. Patents on Coal. A. Pott and H. Broche. U.S.P. 2,147,753, 21.2.39. Appl. 30.11.35. Production of extracts from solid carbonaceous substances by means of solvents—*e.g.*, tetraline and phenol—at 300–420° C. and at 10 to below 100 atm./sq. cm. pressure. The reaction is carried out in a closed vessel, and hydrogen is introduced during the extraction, and the extract slightly hydrogenated using a molybdenum dioxide catalyst.

E. Slatineanu. U.S.P. 2,151,165, 21.3.39. Appl. 18.4.36. Production of hydrocarbons from carbonaceous substances by treating them at 390° C. with a gas mixture containing substantial quantities of methane at at least 500 atm. pressure above normal, to cause polarization of the CH_4 present. W. S. E. C.

544. Patent on Shale. J. J. Crawford. E.P. 499,141, 18.1.39. Appl. 18.6.37. Treatment of kerogen-containing shale for the recovery of oil. W. S. E. C.

Economics and Statistics.

545. Economic Aspect of the World Asphalt and Bitumen Industries. W. Schmidt. *Rev. Pétrolif.*, 1939 (828), 350–354.—The author gives a statistical review of the production and consumption of natural asphalts and bitumens in the various countries of the world from 1909 to 1937 in the case of natural asphalts, and from 1924 to 1937 for bitumens. For purposes of discussion, the countries are divided into three groups: those treating their own crude petroleum for bitumen manufacture, those treating their own and imported crude, and those countries such as Great Britain which treat only imported crude. Two tables are given showing world production of natural asphalt and bitumen in thousands of tons over a period of years, and a third table shows exports, imports, and consumption of bitumen in thousands of tons for the year 1937, the world consumption for that year amounting to over 8 million tons. E. W. H.

546. Industrial Utilization of Fats and Oils. A. Guillaudeu. *Industr. Engng Chem.*, 1939, **31** (2), 158–162.—The principal uses of various fats and oils are outlined, and an attempt is made to forecast the trend of future developments in the oil-and-fat industry. H. E. T.

547. Increase of Tax on Petroleum in Ecuador. Anon. *Bol. Inform. Petroleras*, Sept. 1938, **15** (169), 119–120.—Decree constituting an increase of the taxes imposed on the 30.8.35 under concession to the Anglo-Ecuadorian Oilfields, Ltd. H. I. L.

548. Regulation of the Petroleum Industry in Portugal. Anon. Translated from *Diario de Governo*, 12.2.37. *Bol. Inform. Petroleras*, Sept. 1938, **15** (169), 106–118.—This decree (Act no. 1,947) comprises the Portuguese Government regulations controlling importation, storage, and use for industrial purposes of crude mineral oils, their derivatives and residues. It also covers the exploitation of mineral oil deposits in Portuguese Territory. H. I. L.

BOOK REVIEWS.

The Miocene Stratigraphy of California. By R. M. Kleinpell. Pp. 450, 22 plates, 5 folding charts (in pocket), 9 figs. and 17 tables in text. Tulsa, Okl.: Amer. Ass. Petrol. Geol., and London: Murby. 1938. $5.00.

This handsome volume claims to resolve the confusion hitherto surrounding the correlation of the Miocene formations of the several basins of California. As in so many other cases, what have been assumed to be formations of precise age-value, in simple sequence, are now explained as overlapping facies-formations of varying time-duration. The familiar names Vaqueros, Temblor, Monterey, and Santa Margarita must now fall into the same category as the English Greensand formation or the Upper Lias Sands. To determine their age-value in any area, recourse must be had to fossils of zonal value.

The clue to the sequence is found by the author in the Monterey Shales of the Reliz Canyon, Paso Robles Basin, where he distinguishes fourteen foraminiferal zones, for which he claims the same value as that of Jurassic ammonite-zones. Before arriving at this conclusion he discusses with great clarity the ecology of the foraminiferal faunules, and the discrimination between facies-marking and dating value. This long discussion (pp. 79–99), in which the views of Oppel, Arkell, and others on Jurassic zones are set forth, is of interest to other geologists than those concerned with the Miocene.

The fourteen zones (subdivided into zonules) he groups into six stages (or, rather, five and a half, the upper part of his highest stage having no foraminiferal fauna), to which he assigns entirely new names, with a seventh (Oligocene) below; These are, in ascending order: Refugian (Oligocene), Zemorrian and Saucesian ("Lower Miocene"), Relizian and Luisian ("Middle Miocene"), Mohnian and Delmontian ("Upper Miocene"). Correlation follows with six other Californian basins and others farther north. Correlation with mammalian faunas is attempted: the *Merychippus* faunas appear to be mainly Luisian, but ranging above and below; the *Desmostylus* fauna of Kern County, Relizian. European correlation is only suggested broadly, but it would seem that the Californian "Lower Miocene" would be called Oligocene here, and the highest "Upper Miocene" may be equivalent to Sarmatian.

Tabulations show how Vaqueros, Temblor, Salinas, Monterey, and Santa Margarita overlap one another in time and have no such precise age-value as is claimed for the new stages.

For those who are working at these Miocene formations in the field and laboratory, there is a series of range-tables of foraminifera, the most elaborate of which gives the range of some 450 species and varieties; whilst a folding table gives the much more detailed distribution of 132 of these in the type-section (Reliz Canyon), distinguishing over 150 horizons (at 10 or 15 ft. intervals) in 1635 ft. of Monterey Shale.

These questions of correlation constitute the first half of the book, which gives outline maps of the type-areas of the seven new stages. There is also a contoured map, with collecting localities, of the Reliz Canyon: this, unfortunately, has no scale, but from comparison with sections given elsewhere it would appear to be about 2·8 in. to the mile, or 1 : 22,630.

The second half of the book is a systematic catalogue of the foraminifera quoted in the first half, illustrated by 22 photographic plates. A tentative course for the evolution of the genus *Siphogenerina* is suggested. It is interesting to note that no addition has been made to the solitary record of *Lepidocyclina* by Taliaferro and Schenck, six years ago.

There is an admirable index, and extensive bibliographies.

A. Morley Davies.

Physical Constants of Hydrocarbons, Volume 1. Paraffins, Olefins, Acetylenes and other Aliphatic Hydrocarbons. By Gustav Egloff. Pp. 403. Reinhold Publishing Corp., New York, or Chapman & Hall, London. 45*s.* net.

When the Universal Oil Products Co. publish a work composed entirely of data, statistics, and bibliography, petroleum chemists will feel assured, without the recommendation of a reviewer, that no organization is better fitted to compile such a book, so high is the reputation in the petroleum world of the records and filing department of this company.

The developments of the petroleum industry are to-day proceeding along lines which concentrate attention less and less on the natural mixtures of uncertain composition, and more and more on the isolation, identification, and utilization of individual hydrocarbons, for these latter, obtainable from petroleum by distillation or by decomposition, now form the raw materials for the manufacture of a rapidly expanding range of commodities from aviation fuels and alcohols to rubber and resins. The primary necessity of the research chemist, in whose hands the future development of the petroleum and the synthetic chemical industry rests, is a precise knowledge firstly of his raw material and secondly of his derived products, and this knowledge depends *au fond* on the physical constants of the hydrocarbons he uses.

Dr. Egloff has therefore done a great service to petroleum chemists by preparing in a series of four volumes, of which this is the first, a very full series of tables of the physical properties of the hydrocarbons. These embody melting and boiling point at a range of pressures up to the critical point, expansion coefficient, specific gravity, and refractive index. The literature has been thoroughly searched, and every figure recorded bears its bibliographical reference. Those chemists who have had to seek for such information and have found a variety of inconsistent results will appreciate Dr. Egloff's action in printing in heavy type the figure he considers most reliable.

Not the least interesting part of the book is the introduction, in which Dr. Egloff gives an account of the sources of his information. He makes it evident that, in addition to the extensive publications from the laboratories of the oil companies, a vast amount of co-operative research is in progress in America, financed and assisted mainly by the big petroleum corporations working in concert with the Universities and collaborating with such organizations as the Bureau of Standards.

This volume, which is limited to the open-chain hydrocarbons, and those which will succeed it and deal with the closed-ring types of hydrocarbons, are reference books which no petroleum research laboratory can afford not to buy.

F. B. Thole.

Histoire et Archéologie du Pétrole. Extrait du Tome IV. IIme Congrès Mondial du Pétrole, Paris. 1939. Pp. 95.

M. Maurice Mercier, President of the Economics Section of the 2nd World Petroleum Congress, records that it was with considerable doubt as to its ultimate success that it was decided to devote a section of the Congress to the history and archæology of petroleum, a section with no precedent at the London Congress of 1933. With the exception of scattered references in military history to the use of "Greek Fire," and certain well-known quotations from the Bible and Pliny, there appeared very little data to work upon. But in January 1936 M. André Seguin published a scholarly treatment of the history of petroleum in Greek and Roman times. A month or so later R. J. Forbes' monograph on "Bitumen and Petroleum in Antiquity" appeared (Leiden, May 1936). With these enthusiastic collaborators M. Mercier finally arranged an archæological section of the Congress. It is a proof not only of M. Mercier's own interest in the subject, but also of the real wealth of information available, that this section was so successful.

Nine papers covering the fifty centuries of petroleum in the Old World before the first well was drilled in the New were assembled for the Congress. These have now been reprinted as an excerpt from Volume IV of the *Proceedings*. The list of the papers is as follows :—

R. J. Forbes (Amsterdam).	"Sketch of the History of the Petroleum Industry."
Prof. E. Herzfeld (Princeton).	"The Aryan Myth of Naphtha."
André Seguin (Paris).	"Petroleum in Ancient Egypt."
,, ,,	"Petroleum in Western Asia in Ancient Times (Elam and Mesopotamia)."
,, ,,	"Petroleum in the Orient (Canaan, Carthage, and the Hittites)."
,, ,,	"Petroleum in Ancient Greece and Rome."
L. Lockhart (London).	"Persian Petroleum in Ancient and Mediæval Times."
T. Mikucki (Lwow).	"History of the Polish Petroleum Industry."
M. Mercier (Paris).	"Laboratory Verification of Certain Aspects of the History of Petroleum."

The excerpt is completed by a verbatim report of the Session of 14th June, 1937, presided over by M. R. Dussaud, Membre de l'Institut, at which the above papers were discussed. The General Summary prepared by M. Jules Toutain summarizes the nine papers.

The greater part of the material now collected together for the first time consists of literary references and interpretations. This is in itself an achievement, in that it provides the essential data on which a connected history of petroleum in antiquity can be based. Mr. R. J. Forbes has, indeed, attempted this task. He has displayed historical judgment in presenting the various epochs in the history of petroleum in their proper perspective, relating them to the appropriate stage in the development of civilization. The modern interpretation of the function of archæology is that of supplementing or correcting recorded history, and it is to be hoped that M. Mercier will continue his investigations in that spirit of scientific research exemplified in his own contribution to this valuable symposium of papers.

S. J. ASTBURY.

PUBLICATION RECEIVED.

British Standard Specification No. 829 for Mild Steel Drums for Inflammable Liquids. February 1939. Pp. 16. British Standards Institution, 28 Victoria Street, London, S.W.1. Price 2*s*.

This specification relates to welded mild steel drums intended to be used for the storage and conveyance of highly inflammable liquids not completely miscible with water, and of moderate vapour pressure and flashing below 75° F., when tested in accordance with the Petroleum (Consolidation) Act of 1928. It represents an advance in the technique of transporting petroleum products of an inflammable nature, inasmuch as it has been found possible to standardize a lighter drum than was previously in use. This has been achieved through the active co-operation of the Railway Companies and the Oil Companies, and the tests on lighter drums undertaken by the courtesy of the Railway Companies have demonstrated that it is possible to use a lighter drum without any material sacrifice in the safety requirements for the carriage of inflammable products.

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Geology.

549. Geology and Development of Keokuk Pool, Seminole and Pottawatomie Counties, Oklahoma. H. L. Rau and K. A. Ackley. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23** (2), 220–245.—Located in the north-west part of Seminole and the north-east of Pottawatomie, Keokuk Pool was the first pool in Oklahoma where reservoir pressures were maintained through voluntary restriction in the rate of production.

Stratigraphically, the surface rocks of the area consist of sands and shales of the Pontotoc group (Upper Pennsylvanian). At approximately 80 ft. below the surface the Pawhuska limestone is encountered. This is followed by nearly 4000 ft. of other Pennsylvanian sediments and 375 ft. of Mississippian beds before the Silurian and Devonian producing zones are reached. The sub-surface formations are shown in a generalized vertical section, and are described in the order in which they were encountered by the drill.

Structurally, the Keokuk pool is anticlinal and faulted on the east side. The area was affected by at least three periods of adjustment with intervening periods of submergence and more or less continuous deposition. The chief cause, however, of the faulting and folding in the Keokuk Pool was probably the period which occurred in early Pennsylvanian or late Mississippian time.

The Misener sandstone is the main producing formation in the Keokuk Pool, and from this and the underlying Hunton limestone 6,362,224 brls. of oil have been obtained from 106 wells to January 1938. It is estimated that a final recovery of 8000 brls. per acre may be expected from this zone in the central and south parts of the pool. Moreover, it is thought that 1000–2000 brls. per acre may be recovered from the Pennsylvanian zones. G. S. S.

550. Lisbon Oil-field, Claiborne and Lincoln Parishes, Louisiana. V. P. Grage and E. F. Warren, Jr. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23** (3), 281–324.—Discovered in December 1936, the Lisbon Field is the fourth producing field developed in Claiborne Parish, Louisiana.

Underlying the Lisbon Field occur the Comanche Cretaceous rocks, which is an important series from the standpoint of oil development in this region. It is from the Patton limestone zone of Lower Glen Rose age, at an average depth of 5200 ft., that production is obtained. The limestones are very porous and of variable lithological character and thickness; the predominant type is a coarse-textured oolitic rock with varying admixtures of fine-grained sand and calcareous mud. It is likely that localization of oil may have originated in these porous limestones.

It would appear from present data that the Lisbon field is a south-west plunging nose, open to the north-east, with major structural axis aligned N. 30° E.

Peak production was reached during October 1937, when the greatest daily allowable was 15,000 brls., the total for the year being 2,440,640 brls. On 1st February, 1938 the State allocated 10,000 brls. daily, based on 3252 developed acres.

G. S. S.

551. Stratigraphy of Osage Sub-series of North-eastern Oklahoma. L. R. Laudon. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23** (3), 325–338.—In this paper the author confirms evidence advanced by L. M. Cline in his generalized report on South-west Missouri, North-west Arkansas, and North-east Oklahoma. Detailed stratigraphical sections throughout the area are now recorded and measurements given of exposures in the Osage subseries of the Mississippian in North-east Oklahoma.

Faunal collections from each of the recognizable zones within the formations have also been made. G. S. S.

552. Oil Prospecting Licences in Palestine. Anon. *Petrol. Times*, 8.4.39, **41** (1056), 444.—A map is given which shows the approximate positions of a number of prospecting licences granted in Palestine. All have been taken up by the Iraq Petroleum Co. on behalf of Petroleum Development (Palestine), Ltd. G. D. H.

553. "Anglo-American's" British Oil Search. Anon. *Petrol. Times*, 25.3.39, **41** (1054), 377–378.—Midlothian No. 2 has been completed at a depth of 2942 ft. and is

to be tested, for seven prospective oil horizons have been noted. The porosity of these horizons is low, ranging from 3% to 12%, and hence the results are likely to be poor. This well is also 400–600 ft. lower structurally than No. 1, as a consequence of which the sands may be watered. Midlothian No. 3 is to be drilled 220 yd. north-east of No. 1. G. D. H.

554. Progress of "D'Arcy Exploration's" British Oil Search. Anon. *Petrol. Times*, 29.4.39, **41** (1059), 541.—A further geological bore is to be drilled at Chaldon Down to investigate the Wealden sands on the flank of an anticline in the Jurassic, which was indicated by the first boring.

After acidization and solvent treatment of the Hardstoft well, the production has settled down to about 2 tons/day, which is a marked improvement on the previous output.

Cousland No. 2 is more than 2000 ft. deep, and in the Oil Shale Group, whilst No. 3 is in the same beds at a depth of over 1000 ft. Shallow geological bores have been drilled at Pentland, and four shallow bores at Balfour (Fifeshire) have proved the existence of an anticline.

Gas was encountered at 4212 ft. in Eskdale No. 2, but mechanical difficulties have delayed testing. The Carboniferous Limestone was devoid of oil at Gun Hill, although the Millstone Grit and the Limestone Shales had small indications of oil. The Eakring test is in Permian limestone at a depth of 1200 ft. Geological bores are in progress at Formby (Lancashire) and Ashby (Derbyshire). G. D. H.

555. Alberta's Remarkable Oil Progress in 1938. J. L. Irwin. *Petrol. Times*, 25.2.39, **41** (1050), 255–257.—The Alberta production in 1938 was 6,742,039 brls. of oil, against 2,796,908 brls. in 1937. The two most important events of the year were the bringing into production of Home No. 2 (2 ml. north-west of the most northerly crude producer of Turner Valley) and Okalta No. 6 (1 ml. west of the southern proven zone). The former was completed below the porous zones at a depth of 8495 ft. It is 17 ml. from the proved crude zone at the southern end of the valley. The second well is being held up by water troubles. At the end of 1938 there were sixty-four crude producing wells in Turner Valley.

Gas conservation was introduced in 1938 and a new basis for proration came into force.

Gas sands have been encountered in North Taber Royalties No. 1, and oil has been revealed in the Ribstone area. The Ram River well found oil in the Devonian at 400 ft. Tests are being made in various other regions: the Alberta–British Columbia boundary, the Brazean area, Saskatchewan border, at Steveville, Moose Dome, the Crows-nest area, Castle River, Savannah Creek, Milk River, and Del Bonita.
G. D. H.

556. Oil Deposits in Chile. H. Falcke. *Petrol. Z.*, 1939, **35**, 10–12.—The Government of Chile has stopped all subsidies for further drilling in the area of the Magallanes, so that there is no possibility of Chile becoming an oil-producing country in the next few years. On the other hand, the observations of the author during his repeated visits to the country appear to indicate that there is some hope of finding oil deposits, mainly in the area of the High Cordilleras in the far north. E. W. S.

557. Position of Oil Deposits in Germany and their Stratigraphical Classification. W. Haack. *Petrol. Z.*, 1939, **35**, 61–62.—An index in connection with a map made up by the Preussische Geologische Landesanstalt shows the arrangement of the oil-fields from the political and geographical standpoint as well as from the point of view of stratigraphy. A list is given of all the formations where oil deposits have been found in Germany. E. W. S.

558. New Results of Practical Micropalæontology. C. A. Wicher. *Petrol. Z.*, 1939, **35**, 1–2, 65–66.—Report of the 32nd, 34th, and 35th meetings of the Research Division for Micropalæontology, Department of the Prussian Institute for Petroleum Geology, Berlin. Some of the chief geologists of the State and of the companies engaged in

drilling operations in Germany, including some foreign firms, give their opinion regarding the possibility of identifying different strata by shells and other remains of the fossil microfauna. E. W. S.

Geophysics.

559. New Apparatus for the Measurement of Permeability. H. J. Schoene. *Oil u. Kohle*, 1939, **15**, 67–69.—Permeability in darcys is defined as the velocity in cu. cm./sec. of a fluid of viscosity 1 centipoise flowing through a porous material of cross-sectional area 1 sq. cm. under a pressure of 760 mm. of mercury/cm. length of the porous material. Air is used as the fluid the velocity of permeation of which is measured, and the apparatus consists of a compressor delivering air to a reservoir, whence it passes through a control valve, through the chamber containing the porous material under test, and finally through a gas-meter to the atmosphere. The pressure drop across the solid is measured by means of manometers in the air line on each side of it. The volume of air flowing in a given time is measured, together with the pressure fall across the solid under test. From these figures, together with the viscosity of air and the dimensions of the material under test, the permeability is calculated in darcys. T. T. D.

560. Comparison between Direct Measurements and Closed Surveys with the Thyssen Gravimeter. S. von Thyssen. *Beitr. angew. Geophys.*, 1938, **7** (3), 218–229.—Gravimeter surveys may be made by two methods. In the first the instrument is returned to the base after each measurement in the field. This gives a constant check on instrument adjustment and eliminates errors. In the second method a closed survey is made, commencing and finishing at the base. Such a method is quicker, but the distribution of error amongst the intermediate stations is unknown. Surveys were therefore made by both methods in areas around Hanover in order to determine their relative accuracy. Different models of the Thyssen gravimeter were also used, and it was found that some, particularly those with a low-temperature constant, were more suitable than others for closed surveys. The results of the measurements are given in detail, and it is shown that the mean error with closed surveys is about twice that for direct measurements, the latter being 0·1–0·4 mg. S. E. C.

561. Nature of the Seismic-electric Effect. S. von Thyssen, J. N. Hummel and O. Rülke. *Beitr. angew. Geophys.*, 1938, **7** (3), 209–217.—In a continuation of research on this effect experiments were made with an electrolytic cell, keeping the voltage constant. Platinum wire was used for the electrodes and dilute sulphuric acid for the electrolyte. In order to investigate the effect of variation in frequency of vibration, the cell was mounted on an electrically driven shaking machine. It is shown that the curves given by measurements of the effect do not reproduce exactly the mechanical vibrations. The origin of the effect must be sought in the phenomenon of polarization, and the effect of mechanical vibration and current strength is discussed. S. E. C.

562. Frequency of Error Curves as Criteria of Accuracy of Measurement and their Application to the Thyssen Gravimeter. F. Lubiger. *Beitr. angew. Geophys.*, 1938, **7** (3), 230–244.—The gravity anomalies given by the Thyssen gravimeter are differences between the value of gravity at two stations, and the consideration of the errors involved is therefore not that of individual errors, but of differences of errors. This must be taken into account when calculating the frequency of errors. Knowledge of the mean error is important to the geologist, who must apply the measured gravity anomalies to his need. From the point of view of the development of the instrument, however, it is of great importance to know what are the various elements comprised in the mean error. These elements enter into the structure of the curve showing frequency of error, and such a curve will show whether the normal errors are overlain by a series of systematic errors. Curves were drawn for a number of Thyssen gravimeters, and these were all similar and showed secondary maxima. This indicates systematic errors, the origin of which can then be investigated, and the accuracy of the instrument improved. S. E. C.

563. Density Determinations on Rocks from the German Oil Areas. F. Breyer. *Beitr. angew. Geophys.*, 1938, **7** (3), 245–259.—Density determinations were made on core samples, 50–250 gm. in weight, taken where possible at 10 m. intervals. It must be noted that determination of true specific weight, which involves the fluids naturally occurring in the pores of the rock, is rendered difficult by the action of the drilling mud, etc., but it is considered that only small inaccuracies are invoived by neglect of these factors. Cores were taken from wells in three areas: the South Hanover oilfields, the Lower Elbe area, and Mid Baden. In all cases an increase in density with depth is the general condition, but this is not solely a function of depth of burial. The factors involved are the mineralogical and chemical composition of the rock, its porosity, the pressure of the overburden, and the orogenic pressure. These points are discussed with particular reference to the samples in question. Age is not the cause of the higher densities, but it is favourable to their development. The general reason for density differences in sedimentary rocks is not so much variations in their chemical composition as in their porosity. However, the difference between the principal types is relatively small. S. E. C.

564. Geophysical Prospecting with the "Geoskop." L. Waagen. *Bohrtech. Z.*, 1939, **57** (1), 5–7.—Ordinary geophysical methods involve measurements at fixed stations, and, as a result, surveys take several weeks to carry out, and then follows at least an equal length of time during which calculations must be made. These methods are therefore slow and costly, and a personal factor may enter into the interpretation. With the "Geoskop" apparatus measurements are continuous and a direct evaluation of the recorded values is obtained without long calculation. A directional electric field is generated in the earth, and the variations in this field, due in part to the structure and in part to the various materials present underground, are detected. The work is apparently simple, but a skilled personnel is needed to handle the extremely sensitive apparatus and to interpret the curves. Certain preparatory work is necessary before the commencement of a survey in order to find a neutral point—a place where normal values are obtained—for the start. The zero of the instrument may be adjusted so that maximum detail can be obtained as required in either positive or negative values. Interpretation depends on a recognition of the significance of the maxima and minima of the curves. It is claimed that the presence of minerals as well as structure is shown, and a number of actual examples in faulted areas are discussed. S. E. C.

Drilling.

565. Blasting in Modern Deep Well Drilling. R. Feutchtinger. *Petrol. Z.*, 1939, **35**, 4–5.—Ready-manufactured blasting-cartridges for deepening and clearing wells are now available in Germany. Their use is demonstrated in several examples of actual drilling, including the loosening of jammed casings. E. W. S.

Transport and Storage.

566. Cellulose Containers (for Lubricating Oil). K. O. Müller. *Oel u. Kohle*, 1939, **15**, 151–153.—It was required under the four-year plan that the metal cans used in marketing motor lubricating oils should be replaced by containers made of a material produced entirely in Germany. It was suggested that cellulose be used for this purpose, and the military authorities laid down the conditions as to the mechanical strength, nature of impregnating material, and type of stopper required. A container was developed which satisfied all these requirements, but it was decided that the long-fibred cellulose from which it had been manufactured could not be used, as the wood from which it was derived was largely imported. It was further decided that the containers must be manufactured from cellulose recovered from waste paper.

These difficulties, however, have been overcome, and cellulose containers, packed in a holder taking ten, and stored under the bonnet of a car, stood up remarkably well to an arduous journey of 5000 km. over roads and across country. T. T. D.

567. Varnished Containers for Liquid Fuels as Substitutes for Galvanized Drums and Barrels. Anon. *Petrol. Z.*, 1939, **35**, 58.—The reason for the ban in Germany on

zinc for coating containers for liquid mineral oil products is not only the shortage of zinc in that country, but the fear that the deposits of zinc ores in the world as a whole will be exhausted in the near future. On the other hand, it is stated that an output of 200,000 tons of zinc per year from German sources will be possible in a few years. The new coating material is proof even against strong solvents like the German motor fuels, *i.e.*, mixtures of petrol, benzol, and different alcohols. The varnish can be manufactured from German raw materials in unlimited quantities. E. W. S.

Crude Petroleum.

568. Patents on Crude Petroleum. P. R. Hersham. U.S.P. 2,153,560, 11.4.39. Appl. 7.6.34. Desalting and demulsifying oils by treating them with a mixture of sodium naphthenate, formaldehyde, and glycerine at 135° F. in a closed system under pressure, and then recovering the separated oil from the brine.

M. De Groote and L. L. Faure. U.S.P. 2,153,744, 11.4.39. Appl. 28.2.38.

M. De Groote. U.S.P.P. 2,153,745 and 2,153,746, 11.4.39. Appl. 28.2.38. M. De Groote, B. Keiser, and C. M. Blair, Jr. U.S.P.P. 2,154,422 and 2,154,423, 18.4.39. Appl. 12.8.38. Demulsifying agents for breaking petroleum emulsions of the water-in-oil type. W. S. E. C.

Gas.

569. Patent on Gas. Board of Trustees of University of Illinois. E.P. 501,840, 1.3.39. Appl. 1.6.37. Removal of SO_2 from gases by absorbing the SO_2 in an aqueous solution of a soluble sulphite and a soluble bisulphite and then treating the solution with a metallic oxide, *e.g.*, of Ca, Mg, Zn, Sr, Ba, Pb, or Cd, capable of forming an insoluble sulphite, which is removed and the solution neutralized for treating the fresh gaseous mixture. W. S. E. C.

Cracking.

570. Insulating Refractory Gaining Preference in Cracking Furnace Construction. M. G. Van Voorhis. *Nat. Petrol. News*, 8.3.39, **31** (10), R. 82.—Much simpler and lighter furnace construction is possible by the use of the recently introduced insulating refractories. These materials are of composition similar to that of standard firebrick, but by the aeration of the clay before firing their thermal conductivity, weight, and heat capacity are only one-third to one-fourth of that of ordinary firebrick. The reduction in weight permits much lighter foundation construction, whilst their accurate and standard size and shape allow of accurate designing and the elimination of special shapes. Sizes are said to be so accurate that a tight wall can be constructed without bonding cement. The mechanical strength of insulating refractories is much lower than that of standard firebrick, but this is claimed to be no disadvantage in general. An alternative method of construction consists of lining the furnace with 3–4 in. of ordinary refractory backed with 2 in. of insulating material, such a wall being claimed to be as efficient as a 9-in. insulating refractory wall. H. G.

571. Cracking of Paraffin Wax on Aluminium Chloride in the Nascent State. H. Koch and H. Steinbrink. *BrennstChemie*, 15.4.39, **20** (8), 147–152.—Tests have been made to check a method given by Otin and Dima for the cracking of synthetic or natural solid paraffin wax to gasolines containing detectable quantities of aromatics. Contrary to the assertion of the said authors, in the fractions of the cracking gasolines boiling below 120° C. neither benzene nor toluene could be found.

Under the influence of activated Al and HCl, cracking gasolines were formed from paraffin wax, partly containing, besides paraffin hydrocarbons, considerable quantities of alkyl chlorides, which amounted in certain fractions to 15–17%. During fractionated distillation of these gasolines part of the alkyl chlorides decomposed to olefine. The remainder was converted into olefine by treatment with alcoholic potash.

The pure aliphatic nature of the cracking products was proved by catalytic hydrogenation of a fraction distilling between 70° and 90° C.

The present investigations showed no fundamental difference between the action

of $AlCl_3$ in the nascent state and that of the same when already formed, on the constitution of gasolines obtained by cracking solid synthetic or natural paraffin wax.
L. R.

572. Catalytic Aromatization of Aliphatic Hydrocarbons. H. Koch. *BrennstChemie*, 1.1.39, **20** (1), 1–9.—Methods similar to those given in Ital. Patents Nos. 351,078 and 352,747 on catalytic aromatization of aliphatic hydrocarbons were applied to Kogasin fractions. Vanadium and chromium oxide, both on aluminium oxide, were used as catalysts. Based on investigations by Kasansky and Plate, the behaviour of heptene, *n*-heptane, and *n*-octane was examined when passed over platinum on active carbon between 310° and 350° C. Fractions of charcoal-adsorption gasoline boiling above 100° C. were aromatized by exposure for 5 sec. to 520° C. over a vanadium–aluminium oxide catalyst. A Kogasin fraction distilling between 150° and 300° C. was passed over a chromium–aluminium oxide catalyst at 500–510° C. with 3–4 sec. contact period.

Results of the tests show, in agreement with previous examinations, that it is possible, with suitable catalysts, to carry out a deep-seated molecular conversion of aliphatic hydrocarbons into aromatic. Optimum temperatures and periods of contact depend on size and configuration of the hydrocarbon molecules. Consequently, similar to recent developments in non-catalytic cracking, optimum results of aromatization can be expected only with compounds of a high uniformity or with narrow-boiling-range fractions.
L. R.

573. Patents on Cracking. J. W. McCaffrey. U.S.P. 2,149,854, 7.3.39. Appl. 6.1.32. Cracking of hydrocarbon oils to produce a residue and vapours which are fractionated to condense an intermediate product heavier than gasoline, and a lighter fraction which is finally condensed to form gasoline distillate. The gasoline distillate is re-formed, the re-formed distillate recovered, and the gases and the residue from the cracking are hydrogenated independently. The distillates from the hydrogenation are combined with the distillate from the cracking for re-forming.

T. C. Heisig. U.S.P. 2,150,119, 7.3.39. Appl. 10.10.36. Cracking of asphaltic oil in which a propane solvent is mixed with heavy cracking stock to precipitate asphalt, partly removing the solvent, and subjecting the remainder of the solvent and oil to vapour-phase cracking.

O. H. Dawson. U.S.P. 2,150,363, 14.3.39. Appl. 1.12.34. Preparation of a lubricating oil dye from cracked tar.

E. J. Houdry. U.S.P. 2,150,923 and 2,150,924, 21.3.39. Appl. 18.4.35. Catalytic conversion of hydrocarbons by means of adsorbent catalysts, *e.g.*, aluminium oxide or silicate.

L. de Florez. U.S.P. 2,151,386, 21.3.39. Appl. 16.4.29. Improved furnace for use in cracking operations.
W. S. E. C.

Hydrogenation.

574. Patent on Hydrogenation. M. Pier, W. Simon and P. Jacob. U.S.P. 2,154,527, 18.4.39. Appl. 28.12.35. Catalyst for hydrogenation of carbonaceous substances, consisting of a bleaching earth, the activity of which has been increased by treating it, prior to its application, with an agent selected from the group consisting of F, HF, or other compounds of fluorine capable of corroding siliceous material. The catalyst is then washed to remove the fluorine-containing agent.
W. S. E. C.

575. Patents on Dehydrogenation. Society Chemical Industry, Basle. E.P. 501,897, 7.3.39. Appl. 20.7.38. Dehydrogenation of aromatic nuclei—*i.e.*, formation of condensed ring systems by intramolecular dehydrogenation of compounds with the aid of aluminium chloride and a hydrogen acceptor—*i.e.* an aromatic nitro-compound which, in addition to the nitro-group contains one other nitro-group or at least one hydroxy-sulpho-, or carboxy-group.

J. C. Morrell and A. V. Grosse. U.S.P. 2,152,908, 4.4.39. Appl. 11.5.36. Dehydrogenation of paraffinic hydrocarbons by splitting off H_2 in the presence of aluminium or magnesium oxide, together with a small amount of an oxide of praseodymium. W. S. E. C.

Polymerization.

576. Catalysis in the Petroleum Industry. V. N. Ipatieff. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 455–460.—Paraffin hydrocarbons remaining after polymerization of olefines in cracked gases can be dehydrogenated to olefines, which can be again polymerized.

Gaseous olefines can also be converted into viscous lubricating oils. Unsaturated hydrocarbons, obtained from cracked gases and from natural gas, can be converted into aldehydes, ketones, alcohols, glycols, acids, ethers, etc. The author has produced catalysts which yield exclusively polymer olefines.

If olefines are polymerized in the presence of *ortho*-pyrophosphoric acids as catalysts, only polymeric olefines are produced. Thus propylene polymerized at a temperature of 200–225° C. yields a mixture of di-, tri-, and tetra-polymers. The same process at higher temperatures yields considerable quantities of paraffins, naphthenes, and aromatics.

Systematic study should lead to the discovery of catalysts capable of directing polymerization towards specific products. The present and future importance of catalysts in the petroleum industry is discussed. M. M. L.

577. Composition of the Primary Polymerization Products of Propene and Butenes. H. Hogg, J. Smittenberg and G. H. Visser. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 489–495.—The authors have attempted to follow the reactions involved when gaseous olefines, propene, and the butenes are polymerized by passing over a phosphoric acid catalyst under mild conditions. Since the polymerization of olefines produces mainly other olefines, the determination of their structure requires chemical analytical methods. The authors have chosen hydrogenation to paraffins followed by analytical rectification.

The following general conclusions are reached:

(*a*) Quaternary C atoms cannot take part in coupling reactions; if they are formed, rearrangement to tertiary C atoms ensues.

(*b*) Coupling between similar C atoms occurs only in a very slight degree, or not at all.

(*c*) Coupling between a tertiary and a primary C atom takes precedence of any other possible combination.

(*d*) Besides main products formed in accordance with (*a*) to (*c*), secondary products are formed, especially at high temperatures, by more radical crackings, rearrangement, and polymerization. W. P.

578. [Johnson] "Midget" Polymerization Plant Boosts Gasoline Yield Three Per Cent. W. J. Leenhouts. *Nat. Petrol. News*, 8.3.39, **31** (10), R. 92; *Refiner*, 1939, **18** (3), 112.—In the plant described stabilizer tops containing 45–47% propene and butenes are compressed to 500 lb. and passed at 180° F. to the furnace, where the temperature is raised to 325–400° F. From the furnace the gases pass to two catalyst towers 30 in. diameter, 15 ft. 6 in. high, packed with solid phosphoric acid catalyst and operated at 500 lb. pressure. The temperature rise in the first tower is 90° F. and in the second 20° F. A Griscom Russell polymer condenser and a stabilizer tower follow the catalyst towers. The gasoline is stabilized to 10–30 lb. Reid V.P., according to the demand. The blending octane value of the product is 110–120. H. G.

579. Patents on Polymerization. A. L. Mond and Universal Oil Products Co. E.P. 501,776, 6.3.39. Appl. 9.11.37. Polymerization of hydrocarbon mixtures containing propylene, *iso*butylene, and normal butylenes in three stages. Polymerization is carried out in the first stage at 20–66° C. under 3·4–10 atm. pressure in the second stage at 66–121° C. and 10–24 atm. pressure, and in the third stage the propylene is sub-

jected to the action of a solid phosphoric acid catalyst at 205–260° C. and under 6·5–20 atm. pressure.

G. W. Johnson and I. G. Farbenindustrie A.-G. E.P. 501,669, 3.3.39. Appl. 17.9.37. Manufacture and production of interpolymerization products by polymerizing mixtures of fumaric di-esters and *iso*butylene in an aqueous emulsion in the presence of catalysts.

G. W. Johnson and I. G. Farbenindustrie A.-G. E.P. 502,475, 15.3.39. Appl. 15.7.37. Polymerization of olefines into liquid hydrocarbons in which the catalyst carrier is impregnated with a solution of a metal salt in phosphoric acid.

J. E. Westenberg. U.S.P. 2,154,795, 18.4.39. Appl. 15.6.38. Method of controlling temperatures in exothermic reactions—*e.g.* polymerization reactions.

W. S. E. C.

Synthetic Products.

580. Patent on Synthesis. H. Dreyfus. E.P. 500,264, 6.2.39. Appl. 5.8.37. Manufacture of hydrocarbons by the reaction of CO and H_2 in the presence of hydrogenating catalyst consisting of Co-thoria, the absolute pressure in the reaction zone being normally above 0·5 atm., but is periodically reduced to below 0·5 atm. W. S. E. C.

Refining and Refinery Plant.

581. Structure and Origin of Natural Earths Suitable for the Decoloration of Mineral Oils. J. de Lapparent. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 559–568.—The classification of decolorizing earths based on their mineralogical character and molecular structure has been attempted by the author, who considers such earths to be argillaceous earths, the essential constituents of which are, either singly or in mixtures, the three argillaceous minerals "Kaolinite," "Attapulgite," and "Montmorillonite."

From considerations of the structural formulæ of these three argillaceous minerals, the author shows that the decolorizing activity or possibility of activation by physico-chemical means is dependent on the combination of Si ions and –OH ions in the molecular structure, and is in every case independent of the nature of the earth. Kaolinite is stated to be active only when in the form of anauxite and montmorillonite, to lose its activity when heated, owing to the destruction of the $SiMg(OH)_6$ grouping which gives the Si ion–OH ion grouping necessary for activity. The stability of attapulgite to heat is explained by its structure.

The author discusses naturally occurring earths as found *in situ*, and attempts to establish the geochemical phenomena which have occasioned these minerals.

L. W. C.

582. Selection of Naturally Occurring and Activated Decolorizing Earths by Physico-Chemical Methods. C. L. Alexanian. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 569–573.—Dehydration curves and X-ray defraction spectra give a quick and conclusive means of identification and selection of decolorizing earths.

From these data the author has deduced practical rules for the choice of the naturally occurring earths, and explains their activation by partial dehydration. M. I.

583. Influence of Moisture on Decoloration of Lubricating Oils by Earths. L. Delemar, R. Navarre and J. Fischer. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 575–581.—The maximum colour absorption of an activated earth at temperatures below 100° C. is reached when the moisture content of the earth is in the neighbourhood of 10%, whilst at temperatures above 100° C. the maximum is reached at about 20% moisture. These figures vary slightly with the origin of the earth and the method of activation.

This effect of moisture on colour absorption is attributed to the formation of a protective layer of steam on the small particles of earth, and also to the increased surface of absorption due to the disintegration of the larger earth particles by steam bubbles.

The colour-absorbing capacity of the earth is further increased by the passage of steam through the oil during the earth treatment, and inert gases such as nitrogen or carbon dioxide give even better results. M. I.

584. Production of Lubricating Oils by Direct Refining of Crudes by Means of Absorbents. C. Creanga. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 591–596.—The author presents a method for the production of lubricating oils by direct refining of undistilled crude oils, achieved by the use of activated earth. By adding a large excess of absorbent to the crude (150–250%), oil is distributed in a thin film on the absorbent. Extraction with gasoline of low aromatic content dissolves the oil, leaving asphalt, resins, and acids adsorbed in the absorbent.

The gasoline is evaporated and the extracted oil can be distilled to any grade. Quantitative separation and recovery of the various reagents are claimed. M. I.

585. Waste Products Successfully Burned as Fuel at Oil Refineries. A. L. Wilson. *Nat. Petrol. News*, 8.3.39, **31** (10), R. 88.—The necessity of burning large volumes of non-merchantable by-product fuels, such as tank bottoms, acid tars, and sludges, has resulted in the designing of both suitable furnaces and burners. The steam-injection-type burner is so efficient that most fuels of this nature are burned cold or at relatively low temperatures. One burner used successfully operates at 50 lb. pressure on fuel at 110° F. Furnace design usually follows accepted practice, and must approach that suitable for good-quality fuel by allowing adequate volume for maximum requirements. The gas must be kept highly heated and afforded time and space in which to burn completely before reaching heating surfaces. Lead-lined tanks equipped with steam jets for agitation and the maintenance of pumping consistency are usually used for storage. H. G.

586. Reduction of Organic Sulphur Compounds by Oil Washing. C. Cooper. *Chem. and Ind.*, 1939, **58**, 155–159.—The four constituent groups of sulphur compounds which may be present in coal gas are: (1) carbon disulphide, (2) mercaptans, (3) thiophene, (4) carbon oxysulphide (and possibly carbon monosulphide). The first three are known in the liquid form when isolated, but the fourth is a gas, and, on a commercial scale, the carbon disulphide which may account for about 60% of the sulphur compounds present, controls the oil-to-gas ratio required. This is normally 25 gals. per 1000 cu. ft. of gas treated at normal temperatures.

The author describes a commercial process for sulphur extraction employed in this country, where, after leaving the washer, the oil is preheated by an oil to oil heat exchanger, followed by an oil to vapour heat exchanger, finally arriving in the still at 100° C. This process uses from 0·4 to 0·5 lb. of steam per gallon of oil, and recovers 1 gal. of benzole with 50 lb. of steam. Representative working conditions are described which indicate that sulphur content is reduced from 20–30 grains to 5½–9 grains.

Using vacuum distillation by working under a pressure of 4–5 lb. absolute in the still, the life of the absorption oil is increased and sludge formation is avoided. Operating conditions show that sulphur may be reduced from 33 grains to 8 grains, using 30 gals. of oil per 1000 cu. ft. of gas, with a steam consumption of 0·36 lb. per gallon of oil.

The author discusses the case where maximum benzole yield is not required, and shows how it is possible to obtain good sulphur removal under this condition.

Lower washing temperatures and higher operating pressures have been considered, but the increase in capital and power costs, and the inadvisability of introducing extra chemical engineering equipment, have so far ruled out these methods.

W. E. J. B.

587. Reclaiming Lubricating, Cutting and Cooling Oils. F. Deitmers. *Petrol. Z.*, 1939, **35**, 33–35.—Considerable economies in cutting and cooling oils may be made by the installation of a relatively small centrifuge. With a machine of 1 kw. input and 3-kw. for the heating of the oil, it is possible to treat and clean several tons of oil per day, practically without labour cost. E. W. S.

588. Patents on Refinery Plant. W. W. Myddleton. E.P. 501,441, 22.2.39. Appl. 22.7.37. Treatment of steel pipes and containers of chemical reaction chambers to remove sulphur compounds, by allowing hydrogen to flow continuously through them at atm. pressure.

H. Hoppers' Industrieele Mij., N.V. E.P. 501,765, 6.3.39. Appl. 6.9.37. Apparatus for the supply and withdrawal of heat for granular material in chemical, especially catalytic, furnaces, etc.

E. Solcia. E.P. 502,057, 10.3.39. Appl. 27.1.38. Protective coatings for tanks for liquid fuels exposed to the risk of perforation, consisting of a multiple layer envelope, an intermediate layer formed of spongy rubber only slightly vulcanized and containing substances capable of causing the spongy rubber to swell when brought into contact with liquid hydrocarbons, and an interior layer comprising an anti-rust substance adhering strongly to the metal walls of the tank. W. S. E. C.

Chemistry and Physics of Petroleum.

589. Fractionation of Mineral Oils. M. Louis. *II^me Congrès Mond. Pétrole*, 1937, 2 (Sect. 2), 117–121.—The author used physical methods to study distillates of Alsatian crude with a view to determining the principal type of molecules present. The methods used were: (1) distillation using a cathodic vacuum, (2) fractionation by acetone, and (3) a combination of (1) and (2). Mononaphthenes with long side-chains and pentanaphthenes with short side-chains were both found with molecular weights between 400 and 500. J. K.

590. Constitution of Lubricating Oils. J. Müller, S. Pilat, and W. Szankowski. *II^me Congrès Mond. Pétrole*, 1937, 2 (Sect 2), 123–125.—Elimination of sulphonic groups from the sulphonic acids formed in acid refining of mineral oils yields oils of high refractive index and high specific gravity with a C : H ratio of 1 : 1. These oils are substantially aromatic and free from naphthenic constituents. Naphthenic oils are produced by the reduction of high-molecular naphthenic acids to hydrocarbons. Attempts to prepare oils of purely paraffinic structure by systematic extraction from a Pennsylvanian oil yielded products which proved to be cyclic, and it is concluded that *iso*-paraffins, if present at all, are present in very small quantities. W. P.

591. Synthesis of Naphthenic Acids. J. von Braun. *II^me Congrès Mond. Pétrole*, 1937, 2 (Sect. 2), 127–131.—Naphthenic acids are generally either monocyclic, $C_nH_{2n-2}O_2$ or bicyclic, $C_nH_{2n-4}O_2$. Syntheses of monocyclic types are described starting with adipic acid, geranic acid, and *cyclo*pentadiene. Synthesis of bicyclic acids is more difficult, but was achieved from methylated chlorine compounds of tetraline and indene. W. P.

592. Characteristics of Crude Oils. M. Louis. *II^me Congrès Mond. Pétrole*, 1937, 2 (Sect. 2), 133–138.—Various crudes were distilled at atmospheric pressure at 250° C., and the residues obtained were then distilled under cathodic vacuum yielding lubricating-oil fractions and residues.

On each lubricating-oil fraction the specific gravity, refractive index, viscosity at 20° C., and viscosity index were determined, and are expressed graphically. A. F. P. S.

593. Heavy Water in Petrols. A. Maillard. *II^me Congrès Mond. Pétrole*, 1937, 2 (Sect. 2), 139–140.—The percentages of deuterium present in two gasolines of different origin have been estimated by the combustion of the gasoline and examination of the water produced. The water was purified by repeated distillation, concentrated by electrolysis, and its freezing point and refractive index were determined, a blank experiment being carried out with conductivity water.

Deuterium contents of 0·94 part per 1000 and 0·72 part per 1000 are given for the two gasolines examined. J. C.

594. Refractometric Studies on Hydrocarbons. W. Bielenberg. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 141–145.—The refractive index (n_D) is usually determined in the examination of a mineral oil, and can be used to obtain information on the chemical character of the oil by means of a mol. wt.–n_D curve in combination with other figures, such as density, parachor, etc. Since the b.pts. of isomers often differ considerably, the use of a b.pt.–n_D curve is suggested. Similarly dispersion ($n_F - n_C$) is sensitive to differences in constitution, and valuable information can be obtained from curves of dispersion–b.pt. and b.pt. $\frac{n_D}{n_F - n_C}$. Diagrams of these for the different classes of hydrocarbons are given. R. G. G.

595. Application of Raman Spectrum to Study of Gasoline. A. Andant. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 147–150.—The author finds that, for mixtures of hydrocarbons which do not react together, the characteristic Raman rays given by each constituent are not displaced, and that their relative intensities vary according to the proportions in the mixture.

This property of the Raman spectra was applied to gasolines of various origins, and permitted the identification of a number of individual constituents.

The practical application of this method is said to be limited only by the lack of knowledge of the Raman spectra of pure hydrocarbons. T. M. B. M.

596. Analysis of Gasolines and Oils by Means of Infra-red Absorption Spectra. J. Lecomte. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 151–162.—The experimental technique for the study of infra-red absorption spectra of hydrocarbons is described. The dispersion of the spectroscope must be as great as possible, and certain portions of the spectrum of each hydrocarbon are particularly important.

Pure hydrocarbons of various series were studied, and it is shown that, by means of infra-red absorption spectra, isomers and homologues can be distinguished. Mixtures were also examined, and the author indicates that infra-red absorption spectra can be made to yield information as to the composition of a mixture during distillation, etc.

The author discusses the interpretation of the results obtained, and states that it may be possible to forecast the infra-red absorption spectrum of a hydrocarbon from its chemical composition. T. M. B. M.

597. Nitration of Paraffin Hydrocarbons. T. Urbanski and M. Slon. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 163–167.—Paraffin hydrocarbons may be directly nitrated by nitrogen dioxide at temperatures above 100° C. The hydrocarbon vapour mixed with dry NO_2 is passed through a heated glass tube filled with glass or porcelain rings, the product cooled, and residual NO_2 and NO removed by a current of air. The nitrated materials are separated by vacuum distillation.

Hydrocarbons from natural gas and petrol, ranging from propane to *n*-nonane, give from 30% to 80% yields of nitro-compounds, consisting mainly of the mononitro- and primary dinitro-hydrocarbons in the ratio of approximately 2 : 1. The optimum temperature conditions range from 190° C. to 215° C. In the case of methane only traces of nitro-compounds are obtained even at 300° C.

*cyclo*Hexane gives a 28% yield of mononitrohexane at 195–200° C. W. L. P.

598. Physiological Properties of Petroleum Hydrocarbons. R. Fabre. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 169–173.—The physiological action of the various commercial petroleum products has been studied. Gasoline and the light fractions have an anæsthetic effect as well as paralysing the vasomotor nerves, the effects varying with the type of molecule contained in the crude. Benzene and *cyclo*paraffins are very toxic, whilst the straight-chain aliphatic compounds are the least harmful.

Heavy fractions, such as lubricating oils, produce various skin diseases such as acne, eczema, and dermatitis, stated to be due to small amounts of impurities present. As a prophylactic measure, the author stresses the need among workers of a strict attention to body hygiene. J. K.

599. Effect of Metal Oxides on Paraffin Hydrocarbons. G. Egloff and H. S. Bloch. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 461–476.—The experimental work on the conversion of hydrocarbons into more useful compounds by thermal reaction involving metallic oxide catalysts is collated, and the effect of the oxides of chemically similar metals is compared, the oxides being grouped according to the relationships of the periodic system; the physical as well as the chemical properties of the oxides and their catalytic effect on the decomposition of hydrocarbons are considered, and reactions in the presence of clays, pumice, and refractories are also included.

The catalysts are divided into five classes: those which catalyse (1) the decomposition of methane to its elements; (2) the conversion of methane into olefins, acetylene, and aromatics; (3) the dehydrogenation of paraffins to olefins; (4) the dehydrogenation of higher paraffins to cyclic compounds; and (5) the cracking of paraffins to shorter-chain compounds.

The action of promoters is dealt with, and a comprehensive bibliography is included.
J. L. E.

600. Density, Compressibility, Expansion of Light Hydrocarbons. A. P. Van der Vet. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 515–521.—By using a steel bomb as a pyknometer, the density, compressibility, and expansion of liquid propane, butane, and *iso*butane were determined.

Blends of butane and *iso*butane showed no contraction in volume, and their properties were additive. Contraction occurred on blending propane with butane or *iso*butane, necessitating a correction in calculating the density of the blend from those of the components. Details of this correction are given. T. M. T.

601. Absorption and Vaporization. R. Fallah. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 535–541.—Gas-absorption formulæ are deduced and a nonogram is presented for calculation of batch absorption, flash vaporization, and compression of solutions. W. P.

602. Addition of Hydrochloric Acid to Unsaturated Hydrocarbons at Low Temperatures. J. J. Leendertse and H. I. Waterman. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 547–549.—Mono-olefines with from 4 to 12 carbon atoms were treated with dry hydrogen chloride gas at temperatures of the order of minus 78° C. in the absence of a catalyst.

The *iso*-olefines in which the side-chain emanated from one of the carbon atoms of the olefine group were very reactive, giving rapid and almost complete formation of corresponding tertiary chloride. The mono-olefines of the –HC = CH– type were practically inert, but in the presence of a catalyst, such as aluminium chloride, reaction took place, giving, in addition to the monochloride, a mixture of monochlorides of higher molecular weight.

This reaction at minus 78° C. can be used for the preparation of tertiary chlorides and for the separation of a mixture of olefines into its reacting and non-reacting constituents. T. M. T.

603. Aluminium Chloride Reactions on Unsaturated Hydrocarbons. S. S. Nametkin and M. G. Rudenko. *Oil Gas J.*, 9.3.39, **37** (43), 52–57. (Translation from *J. Gen. Chem. U.S.S.R.*, 1937, **7** (69), No. 3–4, pp. 763–775.)—The action of Al_2Cl_6 on the higher unsaturateds—amylene, caprylene, and *cyclo*hexene—has been studied, and it has been found that a more pronounced destructive polymerization and hydropolymerization occurs than in the presence of concentrated H_2SO_4. Two layers are formed, the upper containing unsaturated polymers and saturated hydropolymers, and the latter partly resinified compounds resulting from dehydropolymerization. From *cyclo*hexene, the least reactive of the three hydrocarbons examined, were isolated an unsaturated pentamer-tetra*cyclo*-hexyl*cyclo*hexene- and the corresponding aromatic hydrocarbon—tetra*cyclo*hexylbenzene, presumably formed from the former by hydrogenation to the hydropolymer and subsequent dehydrogenation. It is concluded that the series of reactions undergone by unsaturated hydrocarbons in the presence of Al_2Cl_6 is (1) polymerization, (2) dehydropolymerization of a part

of the polymer to highly unsaturated polymers forming complex compounds or aromatic hydrocarbons in the lower layer, and (3) hydrogenation of the remainder of the polymer with the hydrogen released during dehydropolymerization to form saturated hydropolymers.

The method of preparation and analyses of the fractions resulting from the hydropolymerization of amylene, caprylene, and *cyclo*hexene are given. C. L. G.

604. Ethylene Hydrocarbons Subjected to Hydro- and Dehydro-polymerization. S. S. Nametkin, L. N. Abakumovskaya and M. G. Rudenko. *Oil Gas J.*, 9.3.39, **37** (43), 52. (Translation from *J. Gen. Chem. U.S.S.R.*, 1937, **7** (69), No. 3–4, pp. 759–762.)—In an examination of the reaction between ethylene and concentrated H_2SO_4 it is shown that the stages consist of polymerization followed by hydrogenation, in which saturated hydropolymers are formed, and finally by a reversed transformation—dehydropolymerization in which highly unsaturated compounds are formed. Hydro- and dehydro-polymerization take place when sulphuric acid is substituted by a catalyst, *e.g.* Al_2Cl_6. Two types of conversions are possible: (1) polymerization, which occurs in the presence of dilute H_2SO_4 or $ZnCl_2$ at low temperatures; (2) hydro- and dehydro-polymerization of unsaturated hydrocarbons in the presence of concentrated H_2SO_4 leading to the formation of hydrodimer, hydrotrimer, and saturated hydropolymer, the remaining hydrogen being used in the dehydrogenation of initial unsaturated compounds. In the presence of phosphoric acid the dehydropolymerization results in the formation of aromatics. Thermal polymerization of ethylene at 330° at a high pressure gave a mixture containing 8% paraffins, 60% olefins, and 32% naphthenes, whereas the presence of phosphoric acid under the same conditions gave a mixture of 46% paraffins, 7% olefins, 21% naphthenes, and 26% aromatics. C. L. G.

605. Phase Equilibria in Hydrocarbon Systems Joule-Thomson Coefficients of Methane. R. A. Budenholzer, B. H. Sage and W. N. Lacey. *Industr. Engng Chem.*, 1939, **31** (3), 369.—The Joule–Thomson coefficient for methane was determined over the temperature range 70–220° F., and at pressures up to 1500 lb. per sq. in. The results, which are presented in graphs and tables, are compared with those calculated by other authors from p.v.t. measurements. Isothermal changes in enthalpy and compressibility factors are derived from the data and presented in tabular form. P. D.

606. Equilibria, Reaction Rates, and Yields in Unit Processes. R. H. Ewell. *Industr. Engng Chem.*, 1939, **31** (3), 267–273.—Yields in chemical reactions are determined by two factors—namely, the equilibrium state and the rates of all the reactions concerned. The necessity for clearly defining and separating the effect of these factors is emphasized. Thermodynamical reasoning can state definitely what the final equilibrium state obtained will be, but it gives no information concerning the rate of attaining the equilibrium state in a chemical reaction. The thermodynamics of some industrially important unit processes are discussed, including halogenation, hydration hydrogenation, nitration, and isomerization. Important new sources of thermodynamic data and new methods of estimating approximately the heat, entropy, and free energy changes of reactions in these cases where exact data are not available are discussed. The importance of reaction rates to yields, and the relation of activation energy and reaction mechanism to the rate are indicated, including a discussion of the mechanisms of hydrogenation, addition, and substitution, chlorination, vapour-phase hydrolysis and several other unit-processes. H. E. T.

607. Nitration of *iso*Pentane. L. W. Siegle and H. B. Hass. *Industr. Engng Chem.*, 1939, **31** (5), 648.—This paper deals with the nitration of *iso*pentane in the vapour-phase, evidence being obtained for the presence of each of the nitro-compounds which can be predicted by the free radicle theory of nitration. The theoretically possible free radicles derivable from *iso*pentane are: 2-methyl-1-butyl, 3-methyl-1-butyl, 3-methyl-2-butyl, 2-methyl-2-butyl, 2-butyl, 2-methyl-1-propyl, 2-propyl, ethyl, and methyl. Every nitroparaffin that is theoretically possible by addition of a nitro-group to these free radicles, has been obtained—*e.g.*, 2-methyl-1-nitrobutane, 3-methyl-1-nitrobutane (a mixture boiling at 164–165° C., not separated), 3-methyl-2-

nitrobutane (boiling at 155° C.) 2-methyl-2-nitrobutane (boiling at 150·5° C.), 2-nitrobutane, 2-methyl-2-nitropropane (a mixture boiling at 140° C., not separated), 2-nitropropane (boiling at 120° C.), nitroethane (boiling at 115° C.), and nitromethane (boiling at 101° C.). The pure compounds were separated by careful fractionation, but it was not found practicable to separate the two mixtures.

Acetone, identified by its 2 : 4-dinitrophenylhydrazone (m.pt. 127° C.) was obtained as one of the nitration products.

Nitromethane was identified by its b.pt. (99–100° C.) and by the formation of a red colour due to the presence of the sodium salt of methazoicic acid, when treated with sodium hydroxide.

2-Nitropropane, was identified by its physical constants, and the blue pseudonitrole colour test.

2-Nitrobutane and 2-methyl-1-nitropropane were proved to be present by the nitrolic acid and pseudonitrole test and by the boiling point of the mixture. The phenylthiourea derivative (m.pt. 100–101° C.) of 2-butylamine was obtained from the reduction product of the mixture. 2-Methyl-2-nitrobutane was identified by its boiling point (149·8° C. at 752·3 mm.) and by its insolubility in sodium hydroxide solution. 3-Methyl-2-nitrobutane, boiling at 154° C., was identified by the formation of a blue pseudonitrole when treated with alcoholic sodium hydroxide and sodium nitrite, with subsequent neutralization of the solution. H. E. T.

608. Detection of Phenolsulphonic Acids in the Products of the Interaction between Sulphuric Acid and Mineral Oils. S. Pilat and J. Sereda. *Przem. Chem.*, 1938, **22** (11–12), 459–463.—The sulpho-derivates of the phenols which occur in crude oil were isolated for the first time from products obtained by the treatment of mineral oils with sulphuric acid. After eliminating the sulpho group from mineral oil phenolsulphonic acids, phenols of a molecular weight of about 260 and a formula $C_{17}H_{36}OH$ were obtained.

It was proved that the " Ferri Colour Reaction " of mineral oil β-sulphonic acids, (*Petrol. Z.*, 1934, **30** (19), 1), is caused by the presence of mineral oil phenolsulphonic acids, and is characteristic of them.

Ferric salts of these acids dissolved in organic solvents give an intensive blue or green colour. Water-soluble mineral salts in solid form or water solution cause the disappearance of this colour. Under the influence of temperature and traces of water, the disappearance and reappearance of the colour take place, respectively.

Some of the changes which ferric salts of mineral oil phenolsulphonic acids undergo seem to indicate the participation of a hydroxyl group in reaction with $FeCl_3$, and that the phenomena of tautomerism and desmotropism take place. E. J. W.

609. Kinetics of the Oxidation of Methane. W. Staronka and L. Czerski. *Rocz. Chem.*, 1939, **19**, 259–276.—The rate of oxidation of methane was investigated by the flow method under atmospheric pressure and at temperatures of 460, 470 and 483° C. The volume ratio of methane to oxygen in the reacting mixture was equal to 2·2 and 1. The reaction proceeded in a supremax vessel (volume 1 litre, diameter 80 cm).

Among the products of oxidation, methanol and some peroxide, probably CH_3OOH, were found. These products had never been observed under these conditions. The change in the amounts of initial substances with time was followed by systematic chemical analysis.

The following statements are made :

(1) Among the products which appear at the beginning of the reaction, formaldehyde occurs always in larger quantities than methanol, which is inconsistent with the hydroxylation theory :

(2) The amounts of formaldehyde and methanol increase with the progress of the reaction, and attain maximum values of 0·5–0·8% and 0·8–1·4% of the initial reaction mixture, respectively. The total amount of these products in the early stages of the reaction corresponds to about 20–40% of methane transformed.

(3) The maximum amount of methanol increases with increasing methane to oxygen volume ratio and decreasing temperature.

(4) The oxidation of methane is stoichiometrically inhomogenous.

The results obtained support the theory that the oxidation of methane in unpacked vessels and in the absence of special contacts is a chain reaction of a mainly, but not completely, homogenous character.

The results are illustrated by a number of comprehensive tables and diagrams with English as well as Polish explanations. E. J. W.

Analysis and Testing.

610. Comparison of Methods for Determination of Iodine Values of Gasolines. M. Richter. *Oel u. Kohle*, 1939, **15**, 69–75.—The iodine (or bromine) values of five different types of gasoline (Deutsches Hydrierbenzin, Baku–Benzin, Topbenzin, Deutsches Spaltbenzin and *cyclo*pentene) were determined by the Hanus, McIlhiney, Wijs, Hubl, and Kaufmann methods. In each case the effect of varying reaction time on the result was investigated by stopping the reaction after 15, 30, 60, and 180 min., with the object of discovering which methods reached a definite end point after 60 min.

From the results, which are illustrated by ten graphs and six tables, it was deduced that the most suitable method is that of Hanus, because it exhibits a definite end-point after a shorter reaction time than the others, and because it has the advantages of the titre of the iodine bromide solution remaining constant and of simplicity and reliability.

McIlhiney's method is not suitable for use on gasolines with a short reaction time. On the other hand, it can be used with success for investigation of constitution, as it is possible to estimate simultaneously the amounts of halogen added and substituted.

Wijs' method gives results of the same order of magnitude as does that of Hanus, but does not always give a definite end-point in the given reaction time.

Hubl's method, like that of McIlhiney, gives results rather low compared with the others, and again does not give a definite end-point in 60 min.

Kaufmann's method also fails for this last reason; the results obtained, however, are of the same order as those obtained by the methods of Wijs and Hanus.

T. T. D.

611. Evaluation of Diesel Fuels by Motor Methods. A. W. Schmidt and F. Kneule. *Oel u. Kohle*, 1938, **14**, 1034–1041.—Motor methods used in the testing of diesel fuels are outlined, and the method used by the authors is described in greater detail. Photographs are given showing the effect of varying the compression ratio on the shape of the pressure–time diagrams obtained with various fuels.

Diagrams are also given showing the dependence of ignition delay on compression ratio, and the effect on this relationship of the addition of amyl nitrite, paraffin, "Kogasin," and phenols (from a diesel oil derived from lignite). It is shown that the same effect is obtained by the addition of 40% paraffin, 15% Kogasin, or 1·5% amyl nitrite. 10% addition of phenols makes only a slight difference, but the effect increases more than linearly with increasing addition of phenols.

Curves were also determined for mixtures of cetene and α-methylnaphthalene, and of Kogasin and α-methylnaphthalene, so that, in routine tests, the expensive primary reference fuel, cetene, could be replaced by Kogasin, as a cheap secondary reference fuel.

The coking tendencies of the fuels were measured in the motor itself by heating the injector nozzles electrically to a fixed temperature (205° C., 225° C., and 260° C.), the observed property being the time taken for the power output of the engine to fall by 25%. This property is compared with the German army tests for diesel oils ("Gesamtverschmutzung," asphalt—and coke content), but no correlation can be deduced. Surprisingly good correlation, however, is obtained with the Conradson carbon residues, high values corresponding with rapid falling off in power of the engine.

T. T. D.

612. Torsion-cone Consistometer. M. H. Arveson and L. C. Brunstrum. *Oil Gas J.*, 30.3.39, **37** (46), 83.—The paper describes a torsion instrument for measuring the consistency of greases which it is claimed has certain advantages over the types of apparatus in common use to-day.

In this instrument the force necessary to push a disc through the grease is measured, and the result is expressed as consistency index defined as 100 × cube root of force in gm. required to force a disc 1 sq. cm. area moving at 18 mm./min. through a cup of grease 4 cm. diameter and 5 cm. deep at mid-point.

In the recommended type of instrument the cup is moved at a constant speed against the disc, and the force involved is balanced by a cone submerged in mercury.

Figures are given to demonstrate the accuracy and reproducibility of the consistometer, which has been used by the authors as a plant-control instrument for the past six years. D. L. S.

613. Evaporation Test for Commercial Butane. H. W. Van der Hoeven. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect 2), 523–526.—A 75-c.c. sample of the liquid butane is poured into a previously cooled graduated centrifuge tube. This tube, which is surrounded by an air-jacket, is immersed in a water-bath maintained at 85–100° C., and the sample allowed to evaporate. The temperatures, recorded on a thermometer immersed in the liquid butane, are noted after certain definite volumes have boiled off. The reproducibility of the individual readings is given as ± 0·2° C. This method is offered as an alternative to the N.G.A.A. method of distillation. T. M. T.

614. Estimation of Normal Butane and Isobutane in Mixtures. P. Woog, R. Sigwalt and A. Gomer. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 527–533.—Isothermic compression of a pure gas below its critical temperature yields a volume pressure curve in which—

1. inclined portion corresponds to existence of a single phase—the gaseous phase;
2. a vertical portion corresponds to a mixture of the gaseous and liquid phases; and
3. a very slightly inclined portion corresponds to the liquid phase only.

By comparison of the compression curves of unknown mixtures of butane and *iso*butane with the curves for the pure components, the compositions of the mixtures can be calculated to within 0·5%. An apparatus is described for determining the necessary data using only 1 ml. of material. M. M. L.

615. Application of the Hydrogenation Method of Ter Meulen to Estimation of Sulphur in Gases. G. H. Visser and W. F. Engel. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 543–546.—The disadvantages of the usual oxidation methods of sulphur estimation in gases are avoided by using a modification of Ter Meulen's technique.

The gas to be analysed is passed, together with hydrogen, through a red-hot tube filled with platinized asbestos. Hydrogen sulphide is formed, which is absorbed in N/10 soda and estimated colorimetrically with sodium plumbite. The method will estimate as little as 0·01 mg. of sulphur and in presence of 0·05 mg. variations of 0·002 mg. are detectable. The quantity of gas necessary to give this amount of S, being of the order of 200 c.c., can be handled and weighed in a glass vessel and swept into the combustion apparatus by hydrogen without contact with metal, mercury, or other possible absorbents of S. Furthermore, the determination may be carried out without error in refineries, etc., where the atmosphere contains S and where combustion methods frequently give erroneous results. W. P.

616. Dielectric Stability of Mineral-oil-treated Insulation. F. M. Clark. *Industr. Engng Chem.*, 1939, **31** (3), 327.—The effect of oxidation of an insulating oil on the electrical properties of an oil-treated cellolosic insulation cannot be properly determined by the frequently used beaker test. The author tests the impregnated circulation in the form of a capacitor consisting of eight sheets of 0·0127-mm. linen paper between 0·0762-mm. aluminium foil electrodes. The components are vacuum dried at 100° C. and impregnated with degassed mineral oil. The power-factor test is then carried out at 75° C. and 812 volts per mil, and is continued for about 10 weeks.

The results of such tests using Gulf Coast oils show that the most satisfactory oil

contains a minimum of olefinic material and between 4% and 8% of unsaturated aromatic compounds. Completely saturated paraffin mixtures are not suitable. Aromatic hydrocarbons added for the purpose of increasing stability of the insulating oil should not have paraffinic side-chains.

Oil-soluble contaminants may be split into two classes. The first type give high initial power factors, but this does not seriously increase during the life-test. The other type gives the reversed effect, being without serious effect at the start of a test, but raising the power factor seriously as the test proceeds. P. D.

617. Investigation of Insulating-oil Deterioration: Critical Study of Tests. J. C. Balsbaugh and J. L. Oncley. *Industr. Engng Chem.*, 1939, **31** (3), 318.—Special tests for stability were made on two mineral oils, and on cetane, decalin, and tetralin. The oxidation tests were made by measuring the amount of oxygen absorbed at various temperatures, and the oxidized oil was analyzed to give the quantities of acid, ester, and peroxide formed. There are other oxidation products formed besides these, the main volatile one being water. A suitable test for aldehydes and ketones is lacking. The possibility of a suitable test using Grignard reagent is discussed.

D.C. and A.C. conductivities were also measured. It was found that the conductivity was independent of frequency both before and after oxidation, and was therefore ionic in character. Tests were also made on light absorption of the fresh and oxidized materials, using a spectrophotometer at frequencies from 400 to 700 μ, and the transmission at various wave-lengths were related to conductivity and amount of oxygen absorbed. P. D.

618. Liquid Dielectrics: Chemical, Physical, Electrical Properties of Systems containing Lead or Copper Soaps in Liquid Paraffin. J. D. Piper, A. G. Fleiger, C. C. Smith and N. A. Kerstein. *Industr. Engng Chem.*, 1939, **31** (3), 307.—Power-factor measurements were made on mixtures of copper and lead soaps of a number of acids in liquid paraffin. The experiments were made over a temperature range 20–100° C. The physical properties of the various soaps are given. For the most part a concentration of 0·15% of soap was used. A visual test was applied to determine the temperatures below which the various systems ceased to be homogeneous. The power factors were measured at 60 cycles and 50 volts per mil.

The systems containing lead soaps became cloudy on cooling and had high power factors at temperatures immediately above the point of separation.

The systems containing copper soaps had low power factors at all temperatures. The results indicate that the electrical properties of the system are mainly dependent on the degree of dispersion of the soap. P. D.

619. Determination of the Adsorbing Power of Carbon for Carbon Black Tetrachloride as a Method of Determining its Activity. T. Patryn. *Przeg. Chem.*, 1938, **22** (11–12), 444–448.—The problem of active fillers for the manufacture of rubber is discussed. With regard to carbon black in particular, it is pointed out that attempts to correlate its adsorption power with its active properties have not been very successful.

A method of determining the maximum adsorption power of carbon black for vapours of low-boiling organic liquids is described. It consists in sucking a stream of air saturated with the vapour through a known quantity of carbon black, until constant weight is attained. Special precautions are taken to maintain the carbon black at constant temperature.

As a result of the investigation, a relationship was established between the adsorption power of carbon black and its activity with regard to rubber. It was shown that the adsorption power for carbon tetrachloride increases with increasing activity. Thus active carbon black adsorbs 14·3–10·5%, inactive 3·1–0·64% CCl_4. By this simple and quick method it is therefore possible to predict the behaviour of any carbon black in rubber. E. J. W.

620. Accurate Fractionation of Hydrocarbon Blends. Benzol-Verband. *Brennst-Chemie*, 15.5.39, **20** (10), 181–182.—Reply to a recent article by H. Brueckner (see Abstr. No. 506, 1939) asserting that no essential difference existed between his method and that of the Benzol-Verband.

Distillation apparatus and method of test used are described in detail, and it is claimed that differences are considerable. The Benzol–Verband method enables the separation of benzene and toluene with an intermediate run of only 0·5%. Distillation of specially prepared blends of benzene containing 0·6, 1·7, 3·2, and 5·3% of toluene gave, according to the B.–V. method: 0·65, 1·95, 3·13, and 5·06%.

In general, with 100 cu. cm. quantities sufficiently accurate toluene contents are obtained. L. R.

621. Russian Standards for Steam Turbine and Transformer Oils. P. A. Khokhryakov. *Neft. Khoz.*, January 1939, 25–26.—The newly projected turbine and transformer-oil standards contain, in general, increased requirements. After exposure to the standard "Z.E.S." oxidation test, acidity should not exceed 0·35 mg. KOH (previously 0·6) and insolubles should be below 0·15 (0·1)%. Experiments carried out in the Azerbaidshan Petroleum Research Institute ("Aznii") have shown that oils complying with these specifications can be produced, and that optimum refining results are obtained when 10% acid is used. The demulsification number should not be less than 750. The acidity limit is reduced to 0·04 mg. KOH both for turbine (0·07) and transformer oils (0·05). The maximum viscosity at 20° C. of transformer oil is reduced to 5 (6) °E. A new grade of transformer oil having a pour point of − 35° C. is to be introduced for service in parts of the Soviet Union where the most severe conditions of cold do not occur, *e.g.* North Caucasus, Daghestan, part of the Ukraine, and the Krim. L. R.

622. Rapid Determination of Water in Butyl Alcohol. G. Lazzari. *Chim. e Industria*, 1939, **21** (2), 68–69.—The author mentions the various methods used for the determination of water content in alcohols, including that based on the decrease in solubility of hydrated alcohols in organic solvents. From the quantity of water necessary to produce turbidity in an alcohol–solvent blend, the percentage of water contained in the alcohol is deduced by means of curves. An analytical procedure is then described for the determination of water content in butyl alcohol. To 20 ml. of the alcohol under test, 2 ml. of a benzol-acetone blend (ratio 2 : 1) are added, and water is then added drop by drop from a micro-burette, shaking vigorously after each addition until persistent turbidity of the mixture occurs. Care must be taken that the temperature remains constant during the titration. From tests carried out at temperatures of 16 and 22° C. using pure normal butyl alcohol, a series of values have been derived which, plotted on a graph, represent a curve which is nearly linear. P. G.

623. Analysis of Combustible Gases. G. Pastonesi. *Chim. e Industria*, 1939, **21** (1), 4–8.—The author deals with the utilization of the cracking and hydrogenation gases in the ANIC plants, where they are converted by reaction with steam in the presence of a catalyst at 800° C. to CO, CO_2, and H.

The necessity for an accurate and rapid method of determination of the amount of H recoverable from a given plant is pointed out. These cracking and hydrogenation gases generally contain H_2S, CO_2, N, and paraffinic and unsaturated hydrocarbons. The various analytical methods mentioned, liquefying and successive fractional distillation or use of selective solvents, are too involved for practical purposes, for which a knowledge of the percentage of hydrocarbons and their mean formula is sufficient. From the latter data the production capacity in H of the various gases delivered by the plants can be calculated, and the yield from the conversion of the gases can be controlled.

The author describes a method of analysis based on absorption of the various components of the gases to obtain a blend of hydrocarbons on which, by combustion, are determined H and C, and subsequently the mean formula. P. G.

See also Abstract Nos. 626, 627, 643.

Motor Fuels.

624. Patents on Motor Fuels. N.V. de Bataafsche Petroleum Mij. E.P. 499,678, 27.1.39. Appl. 28.9.37. Removal of mercaptans from hydrocarbon mixtures using aqueous caustic solution containing 25–75% of an auxiliary agent—*e.g.*, ethylene diamine.

Kodak Ltd. E.P. 501,844, 1.3.39. Appl. 1.7.37. Stabilization of motor fuel against gum-formation by the addition of N-alkylaminophenol and N : N^1-dialkyl. phenylenediamine.

Universal Oil Products Co. E.P. 502,110, 13.3.39. Appl. 14.9.37. Stabilization of cracked distillates against gum-formation in which a phenolic fraction boiling between 240° and 300° C., is isolated by distillation from crude phenolic substances separated from cracked distillates, and is re-added in a small amount to the cracked distillate.

E. H. Lang and R. C. Osterstrom. U.S.P. 2,149,351, 7.3.39. Appl. 24.6.35. Stabilization of cracked distillates to prevent gum formation. They are heated to 500–700° F. and maintained under a pressure of 500–1500 lb./sq. in. for a short time to render them susceptible to gum inhibitors but not gum-stable. They are then fractionated to remove constituents heavier than gasoline, and a small amount of inhibitor is added immediately.

D. L. Yabroff and E. R. White. U.S.P. 2,149,379 and 2,149,380, 7.3.39. Appl. 2.1.37. Separation of mercaptans from sour hydrocarbon distillates by treatment with an aqueous alkali metal hydroxide solution containing 40 gm. of sodium iso-butyrate/100 ml. of solution.

A. L. Tannehill. U.S.P. 2,150,084, 7.3.39. Appl. 9.4.36. Refining of benzol light oil for use as motor spirit.

R. E. Burk and E. C. Hughes. U.S.P. 2,150,149, 14.3.39. Appl. 5.3.36. Refining of petroleum distillates to remove sulphur compounds, by treatment in a closed circuit with an aqueous solution of caustic soda and sodium polysulphides.

W. O. Keeling. U.S.P. 2,150,170, 14.3.39. Appl. 10.3.32. Refining of cracked gasolines at high temperatures by means of adsorbent substances and passing the vapours while still hot in contact with sodium plumbite. The hydrocarbons are then fractionated in two stages, one under atmospheric and the other under sub-atmospheric pressure.

W. A. Schultz. U.S.P. 2,151,721, 28.3.39. Appl. 16.5.35. Desulphurizing of hydrocarbons containing non-heterocyclic and heterocyclic organic compounds, by treating the vapours at 600–800° F. with bauxite.

D. L. Yabroff. U.S.P. 2,152,166, 28.3.39. Appl. 28.9.36. Separation of mercaptans from hydrocarbon distillates by treatment with an aqueous solution of alkali metal hydroxide containing 25–75% of a butylene glycol and 15–50% of water, and separating the treated distillate from the aqueous alkali metal hydroxide solution containing mercaptans.

D. L. Yabroff. U.S.P. 2,152,720, 4.4.39. Appl. 28.9.36. Separation of mercaptans from motor spirit by treatment with an aqueous solution of an alkali metal hydroxide containing 15–85% of a compound from the group of amino-alkylamines and alkanolamines the alkylene groups of which contain less than 4 C atoms.

D. L. Yabroff. U.S.P. 2,152,721, 4.4.39. Appl. 26.5.37. Removal of mercaptans from light distillates by extraction with an alcoholic aqueous solution of an alkali metal hydroxide (50–60% of methyl or ethyl alcohol and at least 25% of water and alkali metal hydroxide). The spent solution is regenerated by air-blowing to oxidize the mercaptides to disulphides, which are then removed.

D. L. Yabroff and E. R. White. U.S.P. 2,152,722, 4.4.39. Appl. 22.10.37. Separation of mercaptans contained in hydrocarbon liquids by treatment with an aqueous solution of a metal hydroxide containing a substantial amount of dissolved alkali metal salt of an aliphatic hydroxy carboxylic acid having from 3 to 7 C atoms.

D. L. Yabroff. U.S.P. 2,152,723, 4.4.39. Appl. 1.11.37. Separation of mercaptans from hydrocarbon distillates by extraction with an aqueous solution of caustic alkali (using at least 5% by volume of 2–10 normal aqueous alkali metal hydroxide solution in which is dissolved 15–85% of an aliphatic diamino alcohol having 3 to 5 C atoms).

H. B. Cooke. U.S.P. 2,154,064, 11.4.39. Appl. 31.10.35. Production of motor fuel by cracking hydrocarbon oil to produce gasoline and normally gaseous hydrocarbons. The latter are subjected to polymerization to produce motor fuel.

C. E. Dolbear. U.S.P. 2,154,424, 18.4.39. Appl. 1.3.35. Removal of sulphur compounds and gum from acid-treated petroleum distillates by bringing the distillates in the liquid phase into contact with air and a substance containing quicklime. The treated distillate is then removed and treated with a solid oxidation catalyst comprising sodium ferrite in the presence of air.

M. Mizuta and T. Yoshimura. U.S.P. 2,154,988, 18.4.39. Appl. 11.8.34. Refining of cracked oil by means of metallic soaps of oleic acid dissolved in a volatile organic solvent which will disperse homogeneously in the oil.

T. O. Edwards, Jr., and D. D. Stark. U.S.P. 2,155,007, 18.4.39. Appl. 17.8.36. Refining of cracked distillates by selectively polymerizing the sulphur compounds contained therein. A stream of the oil is cooled to 0–70° F. and allowed to flow upward through several treating-towers containing a contact material, and a stream of sulphuric acid sludge is passed through the tower counter-current to the oil stream and over the contact material.

A. T. Scott. U.S.P. 2,155,367, 18.4.39. Appl. 26.10.37. Refining of benzol by treatment at 130° F. with acid sludge obtained from the refining of light oil with concentrated sulphuric acid. W. S. E. C.

Lubricants and Lubrication.

625. Composition of Lubricating Oil. M. R. Cannon and M. R. Fenske. *Industr. Engng Chem.*, 1939, **31** (5), 643.—A wax distillate fraction of a Van Zandt Texas crude oil having a viscosity index of 60 and a 100° F. viscosity of 169 centistokes was separated by alternate distillation and solvent extraction processes into 0·05% fractions on the original crude. Fractions ranging in viscosity index from — 114 to 109 were obtained, and approximately half of the oil could be blended into a product with a viscosity index of 100. The materials of low viscosity index are very viscous, whereas those of high viscosity index are relatively non viscous. Further refining of the 0·05% fractions in an efficient reflux extraction unit yielded products of widely different properties. No appreciable quantities of materials with intermediate viscosity indexes were obtained, and in all cases where close-cut fractions were processed in the reflux extractor, the transition from the negative viscosity index region to the highly positive region was very sharp.

The viscosity of polynuclear compounds that are undoubtedly in the extract samples increases with boiling point at a rate that is as much as ten times the rate at which the viscosity of the more paraffinic raffinates increases with the same change in boiling point. Thus, many products of identical boiling points differ in viscosity by several hundred per cent.

The data obtained indicate the extreme complexity of lubricating oil. A material balance carried out throughout the work allowed the percentage of any one sample which was present in the original crude to be known. H. E. T.

626. Contribution to the Problem of Lubricating Value. E. H. Kadmer. *Petrol. Z.*, 1939, **35**, 171–179.—The advantages and disadvantages of the Thoma oil-testing machine are discussed and results given of tests on a number of lubricating oils.

From the results it appears that Pennsylvanian oils are more valuable than others, whilst the synthetic oils made in Germany from paraffin wax come next. All other lubricating oils have a lower lubricating value, and strong objections are made to some of the modern methods of refining, including solvent refining of non-paraffinic oils. It is claimed that the value of the refining method can be detected by the machine.
E. W. S.

627. Asphalt in Car Engine Oils. E. H. Graefe. *Petrol. Z.*, 1939, **35**, 178–179.—Alphaltic matter does not accumulate indefinitely if an engine oil is used for much longer periods than is usual. An oil has been tested for asphalt content after being used for seven years continuously in a car engine with occasional draining and filtering. Even the make-up of the supply in the crankcase was made with reclaimed oil. It was found that no asphaltic matter was present. The explanation lies in the fact that the whole of the asphalt is adsorbed by the carbon always present in the form of fine particles of soot in used oil. If, as in modern filters, it is possible to get the free carbon out of the oil, the latter shows no signs of "ageing," according to these tests, and can be used indefinitely.
E. W. S.

628. Patents on Lubricating Oil. W. B. McCluer and M. R. Fenske. U.S.P. 2,149,531, 7.3.39. Appl. 26.12.33. Extraction of lubricating oils with pyridine and precipitating the oil in steps by successively introducing into the solution desired quantities of methylcellosolve and removing the precipitate formed after each addition of methylcellosolve prior to the next addition.

A. B. Brown. U.S.P. 2,149,574, 7.3.39. Appl. 29.6.36. Counter-current extraction of hydrocarbon oils using dichlorethyl ether.

F. P. Vickery. U.S.P. 2,149,752, 7.3.39. Appl. 4.1.34. Production of oils of high saturation by treating petroleum oils or their distillates with acetone and sufficient ethylene glycol to reduce greatly the capacity of the acetone to dissolve the saturates.

W. A. Myers. U.S.P. 2,150,183, 14.3.39. Appl. 18.7.36. Solvent extraction of hydrocarbon oils using as solvent a mixture of nitrobenzene, *o*-nitrotoluene, and diethyleneglycol mono-ethyl ether.

D. S. McKittrick and H. J. Henriques. U.S.P. 2,150,334, 14.3.39. Appl. 20.6.36. Solvent refining of hydrocarbon oil using a solvent containing 10–60% of ethylene glycol monomethyl ether and 40–90% of secondary butyl alcohol.

R. A. Halloran and A. L. Lyman. U.S.P. 2,150,501, 14.3.39. Appl. 1.8.36. Dewaxing hydrocarbon oils by dissolving in the oils before chilling a minor quantity of viscous pitch prepared by treating petroleum cracking still residues with H_2SO_4, removing the sludge, and subjecting the residue to non-cracking distillation under sub-atmospheric pressure to obtain a distillate residue of flash point 400° F.

W. B. Hendrey and E. C. Knowles. U.S.P. 2,150,547, 14.3.39. Appl. 18.11.35. Dewaxing of oils using acetone benzol and an oil-soluble polyvalent metallic soap of an organic acid, and incorporating in the mixed solvent soap a small quantity of montan wax and heating to 160–170° F. The heated mixture is then chilled to precipitate wax.

E. C. Knowles. U.S.P. 2,150,552, 14.3.39. Appl. 18.11.35. Dewaxing oils with a solvent in which are incorporated small amounts of crude montan wax, heating to 160° F., and chilling to precipitate the wax.

B. G. Aldridge and E. G. Ragatz. U.S.P. 2,151,310, 21.3.39. Appl. 26.8.35. Distillation of heavy oil, containing gas oil, lubricating oil, and asphalt, into its components.

O. L. Roberts. U.S.P. 2,151,529, 21.3.39. Appl. 10.6.33. Counter-current extraction apparatus.

S. W. Ferris. U.S.P. 2,151,592, 21.3.39. Appl. 18.7.35. Solvent extraction of lubricating oils of the Pennsylvanian type using nitrobenzene.

F. Schick. U.S.P. 2,151,619, 21.3.39. Appl. 4.8.36. Preparation of substantially pure paraffin wax by treating crude wax obtained from bituminous tar with phenols of low b.pt. After removing the phenol and impurities from the wax, it is sweated and treated with an adsorbent to decolorize it. W. S. E. C.

See also Abstract Nos. 616, 617 and 621.

Gas, Diesel and Fuel Oils.

629. Diesel Fuels Blended from Coal-Tar Oil. H. Kölbel. *Oel u. Kohle*, 1938, **14**, 1042–1049.—The consumption of diesel fuel in Germany almost trebled between 1931 and 1937, but the production remained almost constant at about 10% of the requirements in 1937. Of the internally produced fuel, 45% was from German crudes, 34·6% from lignite-tar oil, 2·8% by synthesis, and 9·4% from coal-tar oil. The author is concerned with increasing the amount of oil derived from the last source.

The chief disadvantage of this last fuel is its low cetene number—20, compared with 60–70 for diesel fuel of petroleum origin. On the other hand, Kogasin II, the product obtained from the Fischer–Tropsch synthesis, has a cetene number of 110–120. Accordingly, a fuel with a cetene number of the desired order can be obtained by blending coal-tar oil with Kogasin II. Unfortunately, the purely aliphatic nature of the latter causes the precipitation of asphaltic matter from the former, with resulting difficulties in storage and excessive coking on the injector nozzles of the engine.

This difficulty is overcome by subjecting the coal-tar oil to a special processing, involving the use of Kogasin II as a selective solvent. This process is economically favourable, as the by-products can be reclaimed and used for other purposes.

Tables are given showing the excellent results obtained by this treatment, both with respect to storability and to the very slight tendency to formation of asphalt and coke. Analysis data of a diesel fuel prepared in this way are compared favourably with those of an imported diesel oil.

Motor tests show the blended fuel to be superior to imported gas oil as regards exhaust temperature and CO content of the exhaust gas; in each case the divergence increases with increasing load. Further, 18 months practical trial has shown that, compared with a petroleum diesel fuel, a blend of processed coal-tar oil and Kogasin II exhibits: high ignition quality—*i.e.* easy starting—small tendency to coking; complete combustion over a wide range of load—*i.e.* good response on acceleration—clear exhaust gas with very low CO content, and correspondingly low fuel consumption at full and over-load. T. T. D.

See also Abstract No. 611.

Asphalt and Bitumen.

630. Rigidity Modulus of Bituminous and Bitumen—Filler Mixtures. T. Lonsdale and J. S. Wilson. *Road Research Technical Paper* No. 6.—It is stated that previous work on bituminous materials has dealt only with their plastic behaviour under steady loads, whereas during the passage of a vehicle over a road the surface is stressed only momentarily, and under these conditions the deformations produced in the material are mainly elastic. The authors have therefore developed a method of measuring the rigidity moduli of bituminous binders, and a description of this is given.

A study was made of the oscillation of inertia discs suspended by a steel wire of known diameter, when constrained at its lower end by a rod of the bitumen, carefully prepared so as to be of even diameter throughout to within 1%. The system was set in oscillation under strict temperature control, and the amplitude and frequency of the oscillations were observed by the movements of a spot of light reflected from a mirror affixed to the steel wire. From the data obtained the rigidity moduli of various bitumens have been calculated. Successive determinations showed that there was no deterioration of the rod, and the reproducibility of results was stated to be reasonably good. It was therefore concluded that the rigidity modulus is a characteristic constant for a given bitumen at a given frequency of oscillation. Using 65 and 20 penetration bitumens, 20 penetration and hard pitch, and Trinidad Lake

asphalt, it was found that the rigidity muduli increased rapidly with decreasing temperature. The highest rigidity modulus observed with the hard pitch was $0{\cdot}14 \times 10^{11}$ dynes/sq. cm., compared with a value of 8×10^{11} for steel.

Experiments made with Portland cement filler showed that the rigidity modulus at any temperature was rapidly increased by an increase in the concentration of the filler, the proportionate increase being a function of the amount of filler added and independent of the temperature. It was further found that the rigidity modulus of a bitumen-filler mixture decreased more rapidly with increase of temperature than the rigidity modulus of the bitumen alone, whilst increase in the frequency of oscillation led to only a relatively slight increase in rigidity modulus. H. G. W.

631. Resin Acids in German Natural Asphalt. J. Jackzel. *Asph. u. Teer*, 1939, **11**, 168–170.—In earlier work it was found that the resistance to displacement of bitumen from asphalt-sand by water or alkali solution increased on storage in air of the asphalt-sand, and that acidic bodies were extracted from the asphalt by alkali solution. An investigation with asphalt from Verf after 3 months storage gave similar results, and the resin acids recovered from the alkali solution after 93 days immersion of the asphalt were yellow, of wax-like consistency, and had an acidity of 1197. During titration of the alcoholic acid solution with caustic potash the solution turned olive green in colour, and gave a white precipitate which dissolved on addition of water, the solution turning golden yellow. The effect of the alkali immersion of the bitumen was examined by: (1) washing free from alkali and drying in air; (2) prolonged boiling of the asphalt (1) in water; (3) extracting the original asphalt with alkali; (4) washing free from alkali and drying in air the asphalt (3). Neither of the specimens showed displacement of the bitumen, and (1), (2), and (4) were as bright as the original asphalt, whilst (3), although dull, was as dark as the original. A further examination of asphalt immersed in alkali for 4 months gave the same results, and, after further immersion in fresh alkali for 183 days, the recovered acids had an acidity of 630. No precipitate was formed during titration, but the bitumen was not displaced. Immersion of a fresh specimen for 144 days gave acids having an acidity of 964. It was thought that the high acid number was due to decomposition of resin acids on heating with caustic potash, and, in an attempt to confirm this, the acids were recovered from the various soap solutions and re-titrated, a lower acidity then being found. This process was repeated a number of times, until a constant value was obtained. After immersion of asphalt-sand in potassium iodide for 97 days, no displacement of bitumen occurred on immersion in water or alkali; further treatment for 146 days gave the same result. The wash-water contained no organic matter, although the asphalt after immersion in alkali or potassium iodide had a film of bright powdered bitumen on the surface. The filtered water was colourless neutral, and gave a residue of calcium sulphate when evaporated. A. O.

632. Electric Strength of Bitumen and Asphalt. T. Temme and Weber. *Bitumen*, 1939, **9** (2), 31–35.—The paper describes the apparatus and procedure employed in determining the resistance to passage of electric current, of 50 cycles periodicity, through bituminous coatings of different thickness. A series of curves show results obtained with blown bitumen alone and containing mineral filler, and floated, compressed, and mastic asphalt. Little difference was found between bitumens of 60/70 and 70/80 (K. & S.) softening point, both carrying a current of 45 K.V. with a thickness of 3 mm., but when mineral filler was added, the load decreased to 32 K.V. for a 3-mm. layer. With floated asphalt the particle size and nature of filler had no influence, and all specimens carried a load of 120 K.V. with a 30-mm. layer. Acid-resisting mastic carried a load of 114 K.V. with a 26·3-mm. layer, and was similar to synthetic asphalt, whilst compressed asphalt, as a result of the higher void content, carried loads of approximately 40 K.V. for layers 30 mm. thick. A. O.

633. Patent on Asphalt. J. B. Heid. U.S.P. 2,154,746, 18.4.39. Appl. 17.10.31. Production of asphalt by blowing an asphaltic base oil with an oxidizing gas in an oxidation zone. W. S. E. C.

Special Products.

634. Chemicals Derived from Pentanes. P. Kendall. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 497–500.—A method is described by which the chlorination products of *n*-pentane and *iso*-pentane may be estimated by examination of the amyl alcohols obtained by the hydrolysis of monochloropentanes; the preparation and uses of the esters, amyl-mercaptans, mono-, di-, and tri-amylamines, and a nitrosoamine are described. The decomposition of amyl chlorines and the production of dichloropentanes as by-products of the pentane chlorination are also given. J. L. E.

635. Products derived from Oxidation of Hydrocarbons in the Gaseous Phase. W. de Piotrowski and J. Winkler. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 501–503.—Mixed hydrocarbons, boiling between 170° and 250° C., are atomized with air at 300° C. into a reaction chamber filled with catalyst, where the reaction is exothermic. The resultant gases are passed to condensers and washers and three fractions obtained boiling between (1) 50 and 150° C., (2) 100 and 200° C., (3) 150 and 250° C., together with a solid residue. These fractions consist of unsaturated hydrocarbons, aromatics, saturated and unsaturated aldehydes, ketones, lactones, phenols, and peroxides. By suitable selection of catalyst the reaction can be influenced to oxidation or to dehydrogenation.

Industrial applications for these products, as made at " Galicja " refineries, include (1) Odorization of domestic gases (Detektol). (2) Denaturing of alcohol (Denoxol). (3) Prevention of deposition of gums, resins, and naphthalene in gas pipes (Denoxol-Solve). (4) As sulphonated products, as wetting agents in detergents, textiles, and dyeing. (5) Improving quality of diesel fuels by increase in cetane number. (6) Improving lubricants by increasing oiliness without increasing tendency to oxidize. W. P.

636. The Furans as Industrial Products. Anon. *Chem. Trade J.*, 3.3.39, **104**, 214; *Industr. Engng Chem.*, Feb. 1939, **31** (2), 178.—Possible applications of furfural include: fungicide and germicide (particularly mercury derivatives); mixed with kerosine or light fuel oil—herbicide; production of valuable phenol-furfural resins (these are cheaper than phenol and formaldehyde resins, and are used to cement electric-light bulbs to the brass bases). Derivatives are used as anti-oxidants and accelerators in the rubber industry. Furfural, furfuryl alcohol, and tetrahydrofurfuryl alcohol are solvents for gums, resins, etc. Tetrahydrofurfuryl acetate is a solvent for dichlorofluoromethane in the refrigerating industry. Furfural is used as a selective solvent for separating anthracene from phenanthrene and carbazole, coloured bodies from wood rosin, for the refining of lubricating oils and vegetable oils, and the improvement of diesel fuel. Furfural derivatives are used as textile wetting agents, flotation agents, as anti-scorch in rubber manufacture, demulsifying agents, and to improve the oiliness of lubricating oils. A potentially large outlet is the addition of furfural or mixtures with phenol or aniline to bitumen aggregate mixes to improve the wetting action and adhesion of bitumen. The resinous film formed also increases the weathering properties. C. L. G.

637. Plastics. A. J. Weith. *Industr. Engng Chem.*, 1939, **31** (5), 557–562.—An account is given of the rise of the plastic industry from the earliest times. This historical article outlines the multitudinous uses of the various types of plastic materials utilized in everyday service and gives some account of the difficulties experienced by the pioneers in this branch of industrial research. H. E. T.

638. Synthetic Organic Chemicals from Petroleum. B. T. Brooks. *Industr. Engng Chem.*, 1939, **31** (5), 515–519.—A review of American research in the production of synthetic organic chemicals from petroleum. H. E. T.

639. Patent on Special Products. Standard Oil Development Co. E.P. 501,670, 3.3.39. Appl. 20.9.37. Improvements in the recovery of condensing agents—*e.g.* boron fluoride catalyst—by treating the reaction liquid with substantially anhydrous

ammonia and separating the resultant NH_3BF_3 complex from the remainder of the reaction liquid. The complex is then treated with concentrated H_2SO_4 at high temperatures to remove the major portion of boron fluoride. W. S. E. C.

See also Abstract No. 621.

Detonation and Engines.

640. Oil Engine Temperature and Deflection Measurements. Anon. Based on a lecture "Recent Measurements on Diesel Engines and their Effect on Design by Robert Sulzer," delivered before the Koninklijk Institut van Ingenieurs, Rotterdam. *Engineer*, 31.3.39, **167** (4342), 398.—The results of temperature measurements showed that, with direct injection, much higher temperatures occurred at the periphery of the piston than had formerly been the case with blast injection. In addition, the problem was further complicated by the consideration that direct injection required a suitable form of combustion space.

Temperature measurements from thermocouples in the combustion space of an engine are given graphically, and show the effect of various engine working conditions. From such temperature measurements it is possible to estimate some of the stresses introduced by temperature variations.

The measurement of dynamic mechanical strain effects was obtained by means of a high-frequency coil arrangement. The results of such measurements led to the conclusion that the stresses caused by temperature were roughly three times as great as those caused by gas pressure.

Some measurements of the gas pressure behind the piston rings are given, which show that, in the case of rings giving a good pressure seal, the pressure behind the top ring follows the cylinder-gas pressure almost exactly, whilst the pressure behind each of the lower rings never reaches a very high value. The effects of temperature distortion will, however, tend to upset the sealing of the rings and allow gases to blow past.

The influence of dynamic stressing on the loading of the running gear was also measured. Under the effect of ignition knock the running gear is distorted and vibrates. The stresses are consequently increased, and become greater in proportion to the increases in pressure gradient in the first phase of combustion. J. G. W.

641. Energy Balance Sheet of the Internal-Combustion Engine. F. W. Lanchester. *Engineering*, 31.3.39, **147** (3820), 388 and 14.4.39, **147** (3822), 448.—The author uses the data given by Dr. J. S. Clarke as a basis for demonstrating his method of analysis.

Calculations and estimates based on the indicator diagram are used to obtain the work done in the various parts of the cycle, from which the heat balance is built up. The method is described in detail, the calculations for each step in the analysis being given in full, and justifications being given for any assumptions made. J. G. W.

642. Power Loss Accompanying Detonation. N. MacCoul. *J. Soc. aut. Engrs*, 1939, **44**, 154–160.—Tests on several cars to determine the power loss due to varying degrees of detonation, and the variation in octane requirement and power output consequent upon change in spark advance, lead the author to question the necessity of ensuring freedom from knock at all times.

It is shown that although only 2% loss resulted from a "medium" knock, it was necessary in various cars to increase the octane number of the fuel by from 14 to 22 points to eliminate such knock.

Tests on a single-cylinder C.F.R. engine using fuel of 44 octane number showed that whereas the torque fell off at about one ratio higher compression than that at which detonation commenced when the spark advance used was that for maximum power on a non-detonating fuel, no such fall in torque occurred if the spark was adjusted for maximum power at each setting of compression on the detonating fuel, the progressive increase in torque being limited only by the onset of pre-ignition. Retarding the spark to the threshold of knock, however, at each ratio caused a rapid fall in power to occur.

Data are given showing the effect on engine temperatures as affected by varying spark advance and compression. Spark plug, piston, and inlet valve temperatures

rose with compression ratio increase, whereas exhaust gas, exhaust valve, and heat losses to jacket were lowered, even during detonation, when spark was set for maximum power. It is concluded that it is desirable to use a compression at least one ratio higher than critical for the fuel to be used, and retard the spark sufficiently to eliminate knock. This procedure results in higher efficiency, but, what is still more important, if it becomes desirable to use a higher-octane fuel, it makes possible a noticeable gain in power by suitably advancing the spark. C. H. S.

643. Measurement of Cetene Number. M. Moynot. *Bull. Ass. franç. Tech. Petrol.*, March 1939, (48), 31–63.—The conception of ignition quality in diesel fuels is not new, but its importance has been greatly accentuated by the recent development of high-speed engines. The author briefly surveys the work of various investigators since 1931 regarding the study of ignition lag and the evaluation of fuels in terms of standard reference fuels. He then describes various means which are, or have been, used to determine cetene or cetane numbers, including the variable-compression C.F.R. engine with bouncing-pin, Penn State method, and the critical compression ratio method of Pope and Murdock. Numerous tests conducted under the auspices of the Institute of Petroleum have shown that good agreement between ratings on different types of engines is possible if suitable secondary standard fuels are used; ignition delay may be determined with a suitable indicator capable of reading to $\frac{1}{4}$ degree of crankshaft angle. Another method is to throttle the air intake until the engine just commences to misfire and note the absolute pressure in the intake manifold. Cetene number is deduced from a previously determined curve relating intake pressure to cetene numbers of known secondary reference fuel blends.

In the Dumanois method a base gasoline is diluted with 25% of the fuel to be tested, and the octane number of the blend is determined. The cetene number of the test fuel is deduced from a calibration curve; the latter is established by measuring the octane numbers of blends of secondary reference fuels added to the base gasoline in the same proportion as the test fuel. The principal advantage of this method is the ability to utilize the standard C.F.R. gasoline engine.

As a standard reference fuel of high ignition quality, cetene has been replaced by cetane, but, in the author's view, cetene has a certain advantage in being easier to prepare; also, the melting point of cetane is rather high. For conversion from one scale to the other it is noted that:

$$\text{Cetane Number} = 0{\cdot}88 \times \text{Cetene Number}.$$

In practice, secondary reference fuels are usually employed; those recommended by the Institute of Petroleum have cetene numbers of 80 and 20·5, respectively.

The bouncing-pin method permits an accuracy of the order of $\pm 1{\cdot}5$ to $\pm 2{\cdot}5$ cetane numbers. The critical compression ratio method is quicker, but less accurate; it is a test of starting ability rather than of performance under normal running conditions. The author shows curves correlating different methods of measuring cetene numbers, and discusses the probable accuracy of these methods. His own experience favours the Institute of Petroleum method, using an indicator on the C.F.R. diesel engine. Nevertheless, there is much to be said for the Dumanois method, provided it is restricted to normal fuels; hence the calibration curve must be made using secondary standard reference fuels.

Ignition delay, in crankshaft degrees, does not show a straight-line relation with cetene number. Hence the accuracy of measurement diminishes with increasing cetene number, whilst, beyond a certain limit, further increase of cetene number cannot result in further shortening of the delay period. The physical nature of ignition delay is discussed, and reference made to researches in which the first appearance of flame in the combustion chamber has been studied in relation to pressure rise as shown by an indicator. However, for practical purposes fuels have to be classified according to smoothness of operation, so that methods based on the pressure diagram are to be preferred.

Finally, the author discusses the suitability of various indices based on the physical properties of fuels, such as diesel index, parachor, etc. He concludes that none of these is suitable for use in specifications, although some may be useful in controlling refinery production. Nevertheless, for specification purposes the cetene scale is too narrowly sub-divided, and a numerical scale ranging from 0 to 20 would be preferable.
K. T. A.

644. Characteristics of Magnetically Actuated Fuel Injection Valve. C. J. Vogt and T. A. Rogers. *Automotive Ind.*, 1939, **80** (16), 530–536.—The article describes some tests made on a system of injection developed by the Atlas Imperial Diesel Co. of California. This employs the "common-rail" principle with a magnetically actuated nozzle. The object of the tests was to compare the characteristics of the new system with those of a jerk-pump system. Spray formation was studied stroboscopically, whilst the electrical aspect was investigated with an oscillograph. It is concluded that the magnetically actuated spray valve offers a means of accurately controlling the quantity of fuel injected per cycle; successive sprays are reproducible, which is an important factor in smooth engine operation, and the system is independent of the dynamics of the pump and fuel column. K. T. A.

Coal and Shale.

645. Annual Report of Research and Technologic Work on Coal. Fiscal Year 1938. A. C. Fieldner. *U.S. Bur. Mines Inf. Circ.* No. 7052, Feb. 1939.—The report gives a *résumé* of recent work on: (1) the properties and composition of American coals, (2) mining problems, (3) the preparation of coal, (4) the utilization of coal, and (5) coking and the properties and utilization of coke, and the hydrogenation of coal.

Under (5) are described an experimental plant for the production of hydrogen from natural gas (containing 90% of methane) using the water-gas reaction, and the hydrogenation unit in which the coal, after mixing with an equal weight of heavy oil and 0·25% of tin sulphide and 0·25% of molybdic oxide and grinding to 200 mesh, is treated with hydrogen at 420–450° C. An assay on Bruceton coal yielded, after a single pass in the convertor, 73% of middle oil (of which 20% boiled in the gasoline range and 80% boiled below 330° C.) and 12–15% of hydrocarbon gases (C_1 to C_4). The middle oil contains 15–18% of tar acids and 3–5% of tar bases, the remaining neutral oil consisting of 6–8% olefins, 67–70% aromatics and 22–27% saturated hydrocarbons. C. L. G.

646. Studies of Certain Properties of Oil Shale and Shale Oil. B. Guthrie. *Bur. Mines. Bull.*, No. 415, 1938.—A compilation has been made of published and unpublished articles written by members of the Bureau of Mines on:—

(1) Testing methods for oil shale and shale oil.
(2) Effects of temperature and time of reaction in distilling oil shales on yields and properties of crude oils.
(3) Assay-retort studies of ten typical shales (from principal deposits in U.S., Scotland, Australia, and Brazil).
(4) Fractional "eduction" of oil from oil shale.
(5) Explosibility of oil-shale dust.
(6) Comparisons of oils derived from coal and oil shale.
(7) Weathering of Green River (Colorado and Utah) shales.
(8) Isolation and analysis of oil-shale nitrogen.
(9) Nitrogen and its compounds in oil shale and shale oil. C. L. G.

647. Luxembourg Oil Shale. G. Faber. *Petrol. Z.*, 1939, **35**, 65–66.—Part of a large oil-shale deposit extending from France to Belgium is to be found in Luxembourg, where it covers an area of 90 sq. km. The shale lies mostly on the surface, only small parts having a thin covering. The average thickness is 10 m. The bitumen content has been tested in a relatively small area, and the oil yield is given as 2·5–9%, varying greatly with depth. Although it is not possible to reach definite conclusions, it is thought that exploitation would pay if, as in France, oil-shale spirit were subsidized to the extent of 1·50 francs per litre. E. W. S.

Economics and Statistics.

648. Development of Petroleum Deposits in the Near East. Anon. *Oel u. Kohle*, 1939, **15**, 153–156.—The present position of the petroleum industry in the Near East is summarized. Reference is made to output, development of new fields, the results

of geological and geophysical surveys, and the areas of the concessions of the various operating companies. Iran is dealt with very briefly, more attention being paid to Iraq and the Arabian East Coast; mention is also made of North-east Persia and Afganistan, and Egypt and Turkey. T. T. D.

649. Reports of Central Petroleum Research Bureau (Argentine). G. Hileman and E. P. Canepa. *Bol. Inform. Petroleras*, January 1939, **16** (173), 17–67.—It is shown that one of the chief difficulties which stands in the way of exhaustive and economical exploitation of the various oilfields in the Argentine is the fact that they are leased to different companies, who are apt to study their own interests without collaborating with the other lessees in order to maintain a maximum yield from the field in question. H. I. L.

650. Production of Petroleum in the Argentine Republic for the Year 1938. Anon. *Bol. Inform. Petroleras*, January 1939, **16** (173), 1–15.—Production rose from 2,600,107 m.^{3} in 1937 to 2,714,824 m.^{3} in 1938. It is noteworthy that whereas in 1937 production by private concerns slightly exceeded that of the Government-controlled wells (Y.P.F.), in the year under review the latter rose very considerably (13·37%), whilst there was actually a slight decrease in the former (4·03%). H. I. L.

651. Official Report Submitted to the Chamber of Deputies by the Executive Power. Anon. *Bol. Inform. Petroleras*, Sept. 1938, **15** (169), 1–49.—Report on the Rules and Regulations governing the petroleum industry of the Argentine Republic submitted at the request of the Chamber of Deputies.

It is admitted that the policy hitherto pursued requires modification in order to encourage the growth of the nation's financial, industrial, and commercial capacity as regards development of the petroleum industry. The question is being carefully studied by the Executive Power.

It is claimed that the Republic possesses potential deposits of petroleum sufficient to meet its requirements, and that it ought not to be obliged to have recourse to international markets. It is a question of encouraging development, by suitably protecting the markets against imports. At present the Argentine markets have no means of defending themselves—*e.g.*, against the importation of crude oil to be refined in the country thus tending to raise prices.

Statistics are given of the consumption of petroleum for the last 10 years, with charts showing home production and imports; particulars and figures for distilleries and refineries are also given, together with data showing production and consumption of petroleum and its sub-products, including imports. Tables are shown giving prices and price variations, and tracing the reductions secured through the Y.P.F., particularly in the case of petrol. H. I. L.

652. Report on the Petroleum Industry in the Republic of Colombia for 1937. S. G. Bernal. *Bol. Inform. Petroleras*, January 1939, **16** (173), 76–95.—Report gives full particulars of operations of the different private concerns, and deals with proposals for legislation to combat the virtual monopoly in refined products held by one of the larger private companies, the object being to increase the benefit accruing to the State by setting up a National Refinery. Moreover, the present conditions allow of nearly all the crude oil being exported without benefit to the State. H. I. L.

653. New Regulations Concerning Statistics of German Foreign Trade in Mineral Oils and Mineral Oil Products. S. Trustadt. *Petrol. Z.*, 1939, **35**, 194–196.—The basis of the import statistics for mineral-oil products has been completely altered, beginning with the current year. All oils imported for re-exportation after being refined do not appear as imports, and the same is the case for the imports for bunkering outgoing ships. One important item has been materially changed—viz., crude oil—in that topped crude will appear together with the crude proper. Up till now topped oil was shown in combination with all "residues heavier than water." Consequently no comparison is possible of the figures of this year with the past. E. W. S.

654. Bohemia and Moravia in the Oil Economics of the Reich. I. K. Turyn. *Petrol. Z.*, 1939, **35**, 213.—Although the effect of the incorporation of Bohemia, Moravia, and Slovakia into the economic body of Germany cannot be foreseen, it can be said already that the supply of mineral oils by Roumania will be favoured for these areas. This is the more likely as Hungary will shortly build up her own oil industry on the base of the oil deposits of Lispe and the newly annexed parts of the Karpatho–Ukraine. E. W. S.

655. Legislation relating to Customs and Taxes for Mineral Oils. H. Flohr. *Petrol. Z.*, 1939, **35**, 201–208.—A summary of the regulations is given, including a large number of exemptions for asphalt, crude oil, spirits for cleaning solvents, and other manufacturing processes, and for diesel oil. It is pointed out that no exemption is granted for diesel oil for ordinary passenger cars. This fact is interesting in connection with several attempts to market diesel cars in Germany. E. W. S.

BOOKS AND PUBLICATIONS RECEIVED.

The Modern Diesel. (Fifth Edition.) Iliffe & Sons, Ltd. Pp. 254. Price 3*s.* 6*d.* nett.

The first part of this small handbook gives some account of the diesel engine from the earliest pioneer work, with special reference to the so-called "high-speed diesel." The separate sections devoted to modern fuel injection systems and cylinder-head design are each of considerable length, and well illustrated.

In view of the rapid progress in the development of this class of engine, extensive revision of the section dealing with Rail Transport has been found desirable, and recent changes in detail and current general design features are dealt with. All the well-known makes of British and foreign engines employed in Road Transport, Aircraft, Rail Traction, and Marine Service are given in tabular form, and the special features in the design of the various makes are described in some detail.

The book gives information on the application of the high-speed diesel engine to various duties in a concise manner, and should serve as a useful reference to those interested in modern practice related to this class of engine.

Gasoline Surveys for 1937 and 1938. By P. V. Rosewarne and H. McD. Chantler. Dept. of Mines and Resources, Canada. No. 796. Pp. 20. J. O. Patenande I.S.O., Ottawa. Price 10 cents.

This report contains the results in detail of the analyses of 120 samples of gasoline collected from wholesale dealers and distributors in nine cities in August 1937 and August 1938. The results show that the average gasoline during 1937 and 1938 was of good quality. According to the analyses, three groups of gasoline are being sold in Canada. These groups differ principally in knock rating. In 1937 and 1938 the average knock rating of Group I Gasoline was 78 O.N., of Group II, 70 O.N., and of Group III, 60 O.N.

Lexicon of Geologic Names of the United States. Compiled by M. Grace Wilmarth. U.S. Geol. Survey Bull. No. 896. 2 parts. Pp. 2396. Superintendent of Documents, Washington, D.C. Parts 1 and 2, $2·50 per set.

Definitions of geologic names giving briefly the lithology, thickness, age, underlying and overlying formations, and type locality. References to the literature from which the material has been gleaned are also given.

Annual Reports of the Society of Chemical Industry on the Progress of Applied Chemistry. Vol. XXIII. 1938. Issued by the Society of Chemical Industry. Pp. 856. Indexes 784–856. Price 12*s.* 6*d.* (7*s.* 6*d.* to Members of the Society of Chemical Industry.)

This well-known collection of reports contains twenty-seven papers, each a condensed record of the notable researches during the past year in the particular industry under review. Of special interest to the Petroleum Industry is the chapter on "Mineral Oils," again ably contributed by Mr. W. W. Goulston, who reviews in twenty-six pages the outstanding developments in each section of the Industry, viz., pipe-lines, prospecting, refining, petroleum substitutes, gasoline, lubricants, fuel oils, asphaltic bitumen, cracking, polymerization, chemical derivatives, special products, and analysis and testing.

The chapter on "Fuel" by Mr. J. G. King and Dr. C. M. Cawley devotes several pages to the production of oil from coal and to synthetic oil fuels. It contains also an interesting note on the progress of the coal dust engine.

Among the other papers of general interest may be mentioned the chapter on "General Plant and Machinery" by S. G. M. Ure and F. J. Bailey and that on

" Gas, Destructive Distillation, Tar and Tar Products " by H. Hollings and W. A. Voss.

Petroleo e seus Productos. By C. E. Nabuco de Araujo, Jr., and others. Pp. 146. Tables, diagrams, illustrations and a short bibliography. J. R. de Oliviera & Co., Rio de Janeiro, 1939.

This book is a collection of individual reports dealing with Geophysics, Polymer Gasoline, Lubricants and Lubrication, Oil Shale and Cannel Coal, Flow of Viscous Liquids, Detonation and Anti-Detonants, and Analytical Methods.

Roads and Road Construction. Year Book and Directory, 1939–1940. Pp. 577. Carriers Publishing Co., Ltd. Price 10*s.* 6*d.*

In addition to a very comprehensive directory of manufacturers, highway officials and organizations this well-known Year Book contains a useful summary of technical developments during 1938. Bibliographical references are given to the more important articles on asphalt, emulsions, tar and testing methods published in Great Britain, U.S.A. and Europe.

British Standard Specification No. 756. Revised May, 1939. " for Apparatus for the Determination of Water by Distillation with an Immiscible Liquid." (Superseding B.S. 614–1936 and B.S. 756–1937.) Pp. 34. British Standards Institution, 28 Victoria Street, London, S.W. 1. Price 2*s.*

The present Specification whilst retaining, with only minor modifications, the less expensive receivers of B.S. 614, includes also receivers with identical graduated portions but fitted with ground glass joints. The size of joint adopted for the top of the receivers is the same as in B.S. 756, so that any of the receivers can be used in conjunction with the condensers specified in B.S. 756, which are also included in the present Specification. The side arm of each receiver terminates in a cone of a ground-glass joint, size No. B.24 of B.S. 572. The receivers can therefore only be used with boiling flasks having a socket of a ground-glass joint, size No. B.24 of B.S. 572.

Two types of apparatus are provided for in the Specification. Type 1 is based on the Dean and Stark apparatus and Type 2 is an apparatus which the Fuel Research Station has found to be well suited for the determination of water in coal and coke.

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Geology.

656. British Petroleum Drilling Campaign. Anon. *Bull. Imp. Inst.*, Jan.–Mar. 1939, **37** (1), 88–103.—Two years have elapsed since the renewed oil search began with the Portsdown well. The Kingsclere well found the Jurassic to be very thick, with 144 ft. of poor-grade ironstone in the Inferior Oolite at 3653 ft. The first Eskdale well was abandoned after prolonged fishing.

The Cousland–D'Arcy structure is relatively free from major faults and shows promising closure. Oil from the old D'Arcy well has been shown to be much like that from the Dunnet mine, which was obviously a distillation product. The intrusions must have given much oil, but in the north-east there are possibilities of true petroleum. The first well on the Cousland dome met five gas sands, some with high potentials, and an oil show at 1248–1275 ft. This well was apparently on the crest, and was sealed. A second well was drilled 200–300 ft. down the flank, and a third has been begun after preliminary geological bores. Geological bores have been put down near Balfour prior to a major test, and exploration has also been carried out along the Pentland fault.

The Anglo-American well, Midlothian No. 1, found several oil- and bitumen-impregnated sands and entered the Devonian. A test was made at 1733–1760 ft., and swabbing gave gas and an oil-water emulsion. After shooting, the oil yield was improved. Pumps have been installed. The output is 350–500 gal. of oil/day with 10,000 cu. ft. of gas. A second well was drilled to 2942 ft., and a third has been begun.

The second Eskdale well reached the Permian at 4196 ft., and a strong gas show was found in the top of the Permian limestone. Shallow borings have been made and geophysical work has been undertaken on the north and north-west flanks of the Cleveland Hills.

The Hardstoft well was deepened until it encountered water. Later treatment with acid, solvent, and shooting greatly increased the oil yield. The Leek test found no satisfactory oil indications in the main limestone.

In the east Midlands the Palæozoic is covered by Permian, Trias, and younger beds. Various bores have shown oil and gas, and two met igneous sills. Geophysical work has confirmed the existence of a roughly north–south ridge in the Carboniferous near Ollerton, and a test has been commenced at Eakring.

The Edale well was abandoned after meeting a strong water flow. The results in the south of England are considered unfavourable, and the Penshurst boring was stopped in Carboniferous limestone at 5600 ft. New areas have been licensed in

Lancashire, Derbyshire, Yorkshire, Fife, and Kinross. Geophysical work has been undertaken in Lincolnshire and the Midlands. To date twelve major tests have been completed and four are in progress. Over thirty geological bores have been drilled. Only the Midlothian No. 1 and Hardstoft wells have been successful. A sum of the order of £500,000 has been expended in the search for oil in Britain.

A tabular summary is given of the borings up to 15th March, 1939. G. D. H.

657. Problems Set by the Development of Turner Valley. Anon. *Rev. Pétrolif.*, 5.5.39 (836), 598–599.—The main events in the development of the Canadian oil industry since 1878 are noted.

Except in the east, where it adjoins the old gas and naphtha horizon, the limits of the producing horizon at Turner Valley are yet undefined, especially in the south. In the north a well 12 miles from the actual field has shown another important oil horizon. An area 5 miles long and 1½ miles wide has been proved, and there appear to be considerable possibilities of further extensions.

In 1938 88·5% of the Alberta production was from the Madison, 10% from the naphtha horizon, and 1·5% of crude from old oil horizons.

Controlled production and proration have been introduced as well as conservation of gas in the naphtha-bearing zones.

Lack of suitable distributing facilities is retarding development. Considerable interest in Alberta is being shown by the British Air Ministry and Admiralty, and it appears likely that some of the major oil companies will embark on exploration there.

G. D. H.

658. Verden Sandstone of Oklahoma—An Exposed Shoestring Sand of Permian Age. N. W. Bass. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 559–581.—This rock is a remarkable narrow, elongated body of sandstone outcropping in a long line of flat-topped buttes and stretching north-westward for a distance of 75 miles from Stephens Co. through South-west Grady and North-east Caddo counties into Canadian Co., Oklahoma.

In width the Verden Sandstone is only 200–600 ft. in most exposures, although locally it is as much as 1500 ft. In thickness it is generally 8–10 ft.

Stratigraphically, the sandstone lies within a sequence of regularly bedded red calcareous sandstone, siltstone, shale, and thin gypsum bands. These beds constitute the Marlow formation, which forms a portion of the red-beds sequence of Permian age. The Verden Sandstone is characterized by coarse-grained beds (8 in. to 2 ft. thick), which are everywhere prominently cross bedded. Interbedded are thin layers of fine-grained sandy shale which contain ripple marks. Marine fossils are common in the Sandstone.

Regarding the mode of origin, two general processes of deposition are indicated: (1) deposition by a stream flowing in a narrow channel, or (2) by waves and longshore currents as some form of barrier beach (offshore bar).

The source of the coarse materials in the Sandstone was probably derived from the conglomerate beds in the underlying Duncan Sandstone. The main source of the calcareous material in the bed was probably derived from shells that had accumulated along the shore and had been pulverized by wave action. Also, much of the calcium carbonate of the Verden Sandstone was probably precipitated directly out of solution by the action of breakers which aerated the water along the growing sand-bars.

G. S. S.

659. Stratigraphic Studies of Baker–Glendive Anticline, Eastern Montana. F. W. DeWolf and W. W. West. *Bull. Amer. Ass. Petrol. Geol.*, April 1939, **23** (4), 461–475.—Three deep wells have been drilled on the Baker–Glendive (Cedar Creek) anticline. The Northern Pacific No. 1 found oil at 6747 ft. and again at 8130–8186 ft., but production was small. A second well 25 miles to the north-west went to 7360 ft., and a third to 6811 ft. The anticline runs for 100 miles from Yellowstone River north-east into the north-west corner of South Dakota. Long ago gas was discovered on it in the Judith River sand of the Upper Cretaceous.

The anticline is asymmetrical, being steeper on the west, and surface mapping shows seven domes, four of which have closures not over 50 ft. The Little Beaver

dome has a closure of 550 ft. Geophysical work in which reflections were obtained at five horizons down to 8241 ft. showed about 50% greater closure at depth and little shift of the axis of the fold. The area surveyed was 42 miles long and 3–5 miles wide. The test well was located on the north-east flank of the Little Beaver dome.

Samples of the formations from the Mowry shales to the Madison limestone were obtained from the Black Hills 90 miles away.

A section of the North Pacific No. 1 down to the Minnelusa (Tensleep) shows shale, sandstone, sandy shale, anhydrite, salt, and limestone. The Upper Mississippian sections are compared with the corresponding sections in Central and Eastern Montana. The upper two-thirds of the Amsden contain dolomite and limestone, and are somewhat cherty, with breccia and conglomeratic zones. In the lower third are shale, dolomite, and limestone. The Big Snowy is believed to begin at 6115 ft. and extend to 7440 ft. It comprises sandstone, limestone, dolomite, anhydrite and black shale; maroon shale, limestone, dolomite, shaly sandstone, and gypsum lenses. The top of the Madison is at 7440 ft. and its base at 8055 ft. It includes anhydritic, oolitic limestone at the top, and light brown dolomite, shale, and dolomitic limestones below. Beneath the Madison are supposed Upper Devonian beds of dolomite and fossiliferous limestones with much shale and gypsum to 8130 ft. and then down to 8186 ft. oil-bearing sandstone, finely porous brown dolomite, and dolomitic limestone.

Lists of fossils from North Pacific No. 1 and Westphal No. 1 (on Porcupine dome 135 miles to the north-west) are given.

It appears that the Big Snowy geosyncline of Mississippian age extends east at least to North Pacific No. 1 and is at least 375 miles long. G. D. H.

660. Geology of Wind River Canyon, Wyoming. C. T. Jones. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 476–491.—Formed by the Wind River cutting through the Bridger–Owl Creek Range, the canyon is 15 miles long and, in places, has a depth of half a mile.

Within the canyon proper the rocks range in age from Pre-Cambrian to Eocene. Overlying the Pre-Cambrian is the Deadwood formation (Middle and Upper Cambrian), which is 1105 ft. thick. This, constituting the thickest sediments in the area, consists of several lithological units, made up of limestones, shales, and a basal member—the Flathead Sandstone. Of the succeeding systems the Mississippian (Madison) and the Triassic (Chugwater) come next in thickness, 530 ft. and 820 ft., respectively. Above the Chugwater to the Upper Cretaceous (Mowry-Thermopolis) the remaining formations are not exposed in entirety in the canyon, being faulted out in part at the north entrance.

Structurally, the Bridger–Owl Creek Range is an east–west trending asymmetrical anticline. The south flank of the dome has been much broken in the canyon by six large and two minor faults; the north flank dips regularly 4° N. Descriptions of these movements are given, accompanied by sections.

From data obtained by the author the more accepted theory is favoured: that most of the mountain uplifts of the Rocky Mountain region, particularly the Bridger–Owl Creek Range, originated by vertical uplifting, and not by ramp thrusting.

G. S. S.

661. Ridge Basin, California. J. E. Eaton. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 517–558.—Ridge Basin is the deepest graben in Coastal California. Its origin, development, and decline are closely connected with the history of the San Andreas and Garlock rifts, as these were the parents of the San Gabriel fault, which, in turn, determined the basin.

Following the inception of the graben (about Middle Miocene time), its point sank rapidly, and formed an inland lake in which was deposited 21,000 ft. of Pliocene and Lower Pleistocene (?) sediments. Later, when deposition had ceased, the basin was deformed and degraded about 15,000 ft. in the Coast Range revolution of Middle and Upper Pleistocene time.

Subsequent development of the drainage is discussed, and it is suggested that the Piru Creek owes its present anomalous upper course to earth movements which prevailed at that period. These were responsible for the present position of Frazier Mountain, which acts as a barrier at the extreme north-west point of the basin.

G. S. S.

662. Areal Variation of Organic Carbon Content of Barataria Bay Sediments, Louisiana. W. C. Krumbein and L. T. Caldwell. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 582–594.—This paper describes the organic content of some bottom sediments collected from Barataria Bay in terms of its areal variation and its relation to the average size of the sediment.

The sediments are classified under five types, and these, with their characteristics, are given in tabular form. Generally, the finest sediments (clay silts) have the largest organic carbon content; the relation between average size and organic carbon seems to be exponential.

Data obtained from the present study are employed in connection with earlier work on "Shoestring" oil sands. It is believed that support is given to N. W. Bass's work in Kansas by providing supplementary data on the processes involved in the migration and trapping of oil.

Maps showing the distribution of the sediments and the location of samples collected accompany the paper. G. S. S.

663. Type Section of Bainbridge Formation of South-eastern Missouri. J. R. Ball. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 595–601.—This section of the Bainbridge formation is about 1 mile south of Moccasin Springs. Outcropping in a vertical cliff, it is about 120 ft. thick, and has been divided up into fifteen units. These consist mainly of limestones—grey, mottled, shaly, and earthy. One unit (No. 12), however, is made up of a compact and well-laminated brownish-black shale having a thickness of 5 ft. It is conspicuous by the presence of abundant *Cyrtograptus ulrichi* Ruedemann. The most fossiliferous unit is No. 10, a dark red, shaly limestone; a list of twenty-two species is given.

Lithologically, the Bainbridge formation is identical with that of Illinois, with the Henryhouse in Oklahoma, probably with the Lafferty in Arkansas, and with some parts of the Silurian strata of Western Tennessee. By further palæontological work, more exact correlations with these formations may be possible. G. S. S.

664. Emba Salt-dome Region, U.S.S.R., and some Comparisons with other Salt-dome Regions. C. W. Sanders. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 492–516.—The Emba Salt-dome area is at the south-west edge of the Asiatic part of the Soviet Union, on the northern shore of the Caspian Sea. It extends north-east at least to Temir, and may include several domes in the Aktiubinsk area.

The age of the salt series is predominantly Upper Permian, although it may include some Triassic sediments at the top. The overburden is much thinner than that of the Gulf Coast, and consists mainly of Jurassic and Cretaceous rocks. Local patches of Tertiary beds also occur with a blanket of Quaternary (Caspian) deposits in the coastal area. The Upper Carboniferous and Permian sections have been correlated by other investigators with the Pennsylvanian and Permian of the Mid-Continent region, based largely on determinations of the ammonite zones. The present author summarizes the main features of these correlations.

The tectonics of the domes are discussed. They are said to constitute structural traps similar to those of the Gulf Coast. Comparisons are also made with the domes of the North German basin, of Iran, and of the Carpathian foothills belt in Roumania. G. S. S.

665. Remains of Former Lakes in the Province of San Luis. E. Fossa-Mancini. *Bol. Inform. Petroleras*, February 1939, **16** (174), 17–42.—Description of a preliminary geological survey of the Province of San Luis, with a view to locating oil deposits. Examination of this territory is particularly difficult, owing to outcrops and sedimentary rocks being largely covered by more recent alluvial deposits of the quaternary period. H. I. L.

666. Exploration Wells of Pisarzowa and Mordawka. S. Weigner. *Przem. Naft.*, 25.11.38 (22), 605–608.—Between the years 1924 and 1927 two deep wells were located in the Western Carpathians near the town of Limanowa on the Magura foldthrust; one at Pisarzowa, another at Mordawka.

The deep well at Pisarzowa was located on a geological window, where Krosno beds are outcropping.

It was carried to a depth of 986 m. The series is composed of compact grey sandstones interbedded with grey sandy shales, where numerous gas and oil horizons were noted.

The deep well at Mordawka, located on a strongly folded and uplifted series of Cretaceous beds, was carried to a depth of 1117 m.

The series was composed of: grey sandy shales 0–178 m.; hornstones and black shales 178–188 m.; grey and black shales 188–258 m.; grey sandy shales, interbedded with sandstones with calcite veins 258–1117 m. Also several oil and gas horizons were noted. E. J. W.

667. Seismic Profile, Stryj-Bilcze Wolica-Rozdol in the Sub-Carpathian Depression. S. Wyrobek. *Przem. Naft.*, 10.5.38 (9), 221–224.—During the years 1934–1936 the Pionier Company carried out a seismic profile in the Sub-Carpathian Depression, between the southern margin of the Podolian Plateau and the Carpathian Range.

The extraordinary deep reflections occurring in this area have been identified with hard, rigid gypsum beds which could serve for exact correlation.

In the course of interpretation the seismic profile was divided into five segments, according to the depth of the gypsum beds and the character of their elastic properties.

As to the tectonics, the gypsum beds seem to be strongly faulted, forming a series of steps dipping southward. E. J. W.

668. Exploration in the Kossow Area. O. W. Wyszynski, J. Czernikowski, and M. Kleinman. *Przem. Naft.*, 10.3.38 (5), 114–119.—During the years 1931 and 1934 the Pionier Company mapped the foreland of the Eastern Carpathians north of the town of Kossow, applying seismic reflection methods.

The existence of an anticline, running with its axial line from Chomczyn to Kobaki, was discovered. The general dip on the northern flank amounted to 3–5°, on the southern to 10–30°.

Clays, shales, lignites, fresh water, and marine sands, sandstones and conglomerates are the chief rocks of the region, and show great resemblance to the gas-field of Daszawa.

Seven wells drilled on the fold penetrated a series of fresh-water sands, underlain by marine sandy shales, with a main gas horizon. E. J. W.

669. Geophysical Prospecting with Application of Seismic Refraction and Reflection Methods in the Gas-field of Daszawa. Z. A. Mitera and S. Wyrobek. *Przem. Naft.*, 25.2.38 (4), 95–99.—In the year 1934 the Pionier Company carried out some exploratory work in the Daszawa district.

As the entire region is covered with thick diluvial deposits, which preclude satisfactory geological studies at the surface, the work had to be guided by geophysical researches. Five profiles were worked out.

The work was intended as an experiment. The determination of the elastic properties of the rocks in the investigated area was very important for the selection of suitable methods and field technique of seismic prospecting. From forty records obtained in the course of the seismic work conducted by the Pionier Company it was possible to tabulate the velocities of elastic waves for most typical rocks of the gas district. The beds showed differences in reflected wave velocities ranging between 1700 and 3000 m./sec.

The existence of two seismic regions was proved: a northern area with shallow reflections, and a southern area with deep reflections. A third area was characterized by lack of either shallow or deep reflections. The interpretation of seismic prospections in the gas-field of Daszawa is a difficult one, due to the complexity of the elastic waves and difficulties in obtaining reliable reflections. E. J. W.

670. Geological Core-drillings in the Rudki Area. O. W. Wyszynski. *Przem. Naft.*, 25.9.38 (18), 494–499.—During the years 1932–1936 the Pionier Company mapped and investigated the foreland of the Eastern Carpathians in the vicinity of Rudki and Drohobycz.

Geological researches, comprising twenty-two core-drillings and application of seismic refraction and reflection methods, proved the existence of the three uplifts at Königsau, Dolhe, and Opary.

This area comprises foraminiferous grey shales, clays with thin layers of tuffs, sand and sandstones of tortonian age, covered up from the south by overthrusted Stebnik beds.

Deep wells at Königsau, Opary, Letnie, and Wroblowice proved that the zone of contact between the Tortonian and Stebnik beds is gasiferous and of great industrial importance. E. J. W.

671. Microfauna from the Jurassic and Cretaceous of North-west Germany. Part I, Lias. C. A. Wicher. *Abh. Preuss. Geol. Landesanst.*, 1938, New Series, No. 193.—The microfaunas of these zones of the Lias are described. There are twenty-seven full-page photographic plates, fourteen of which illustrate the various faunas, and the remainder show many of the typical genera. A standard magnification of × 22 is adopted for the faunas and × 63 in the case of individual forms. None of the photographs has been retouched. S. E. C.

672. Petroleum Deposits and Economics in Territory of Former Czechoslovakia. L. Sommermeier. *Petrol. Z.*, 1939, **35**, 231–237, 322–328, 365–367.—The author considers that there is no possibility of a substantial contribution from these areas to the supply of Greater Germany. Although production could possibly be increased within certain limits in the oil-field of Gbèly belonging to the Vienna basin, there is little prospect of any more oil deposits being found in the Carpathians in the neighbourhood of the Polish oil-fields. E. W. S.

673. New Problems for Petroleum Research and the Search for Bitumen in the Czechoslovak Republic. E. Schnabel. *Petrol. Z.*, 1939, **35**, 141–145.—By the Treaty of Munich 1938 the Republic lost about 80% of her coal deposits, and it is an obligation of the Government to look for other possibilities in the country with a view to making good these losses. There are some indications in many places of oil and of asphalt deposits, but up till now no useful work has been done because of the disorganization of the geological department of the Government. The best experts are used for second-class work, and progress is possible only by the new deal set forth by the author. E. W. S.

674. Deepest Stratum of the Upper Danube. G. Gotzinger. *Petrol. Z.*, 1938, **34** (31), 1–3.—An account of the geology and micropalæontology of cores (1000–1533 m.) taken at Braunau A.I. C. G. G.

675. Discovery of Petroleum at Lobato, Brazil. C. R. Vegh Garzon. *Bol. Inform. Petroleras*, February 1939, **16** (174), 62–67.—Petroleum has been found at a depth of 208 m. in oil-bearing sand close to the sea. The area surrounding the well has been reserved by the Brazilian Government. H. I. L.

676. The Question of Synchronism of Sedimentation and Folding near Mountain Chains. H. Falcke. *Petrol. Z.*, 1939, **35**, 309–314.—Longitudinal depressions or pools as found in or near younger folded mountain chains indicate places where coal or oil has frequently been formed, the theory being almost generally accepted to-day that there is no connection between the formation of coal and oil. According to our present knowledge, coal was formed in such a pool if the remains of terrestrial plants accumulated, whereas the formation of oil took place only if marine sedimentation went on for very long periods under special conditions. The question arises as to whether it was necessary in both cases for the formation of these minerals that the folding of the depression and the sedimentation should have been contemporaneous. Some cases are cited by the author where the deposits have been investigated by taking thousands of samples directly from underground, as in the German coal and oil areas. The conclusion is reached that sedimentation and depression have not always been synchronous, and certainly not in the case of the formation of oil-containing rock. E. W. S.

677. Assumptions and Limitations of Micropalæontology. E. E. Hensoldt. *Petrol. Z.*, 1938, **34** (31), 8–9.—In the author's opinion, the commercial importance of foraminifera in oil prospecting has led to neglect of the study of other microfossils, to the serious detriment of the science of micropalæontology as a whole.

It is suggested that a closer study of other microfossils would remove some serious existing lacunæ in the science, and would yield results of both theoretical and practical importance.

New lines of approach to and development of micropalæontology are sketched.

C. G. G.

Geophysics.

678. The Year's Activities in Electrical, Geothermal, Radioactive, and Oil Analysis Methods. C. A. Heiland. *Geophys.*, 1939, **4** (2), 130–137.—Rosaire considers that deep oil-fields may be reflected in variations in the higher beds, and thus may be located if associated with resistance, reactance, etc., in those beds. He has also found that the depth penetration for electrical transients does not appear to be greater than for other electrical methods under the same conditions. West has described a new method for the determination of the transient characteristics of ground circuits. Jakosky has described a mobile electrode which consists of a spiked wheel on a tractor.

A new development in the Schlumberger method involves the use of a third curve, taken with a greater electrode separation in order to overcome the effect of the drilling mud. Determination of the true resistivity of the oil-sand, the salinity of the water, and of a number of other factors permits the estimation of the oil content of the sand.

A number of papers deal with the extension of the two-layer resistivity theory to three-layer problems. It has been shown that the potential drop–ratio method is superior in resolving power to the resistivity method. The seismic-electric effect has also been discussed, and it has been related to polarization.

Other developments in electrical methods are included under the headings of mining and engineering. The application of systematic records of well temperatures to various problems in bore-holes has been considered. Other geothermal studies include an investigation of the effect of topography on the distribution of isothermal surfaces.

Work on the determination of the age of rocks by radioactive methods continues.

It has been found that sediments overlying favourable structures are characterized by halos of the heavier hydrocarbons as well as by transient anomalies. These patterns do not appear to be related to depth or structure. It is concluded, therefore, that soil analysis methods are primarily adapted to reconnaissance work. S. E. C.

679. Progress in Geophysical Instruments in 1938. S. Krasnow. *Geophys.*, 1939, **4** (2), 123–129.—Such a review is essentially an account of the particulars of instruments released during the year, rather than of the instruments developed during the year.

The reluctance type of magnetic detector is still in general use in seismic work, and improvements are mainly in detail and in the number of instruments in use per set-up. Considerable work has been done on automatic volume-control systems and in the improvement of amplifier units. Power-operated reels are being used to wind up cables, and cheap shot wire is used and abandoned after each shot, in order to avoid the cost of reeling and unreeling.

A number of instruments have been developed for gravity work. A gravimeter by Mott Smith employs an astatic system made of quartz, whilst another by Hoyt employs a helical spring with a mass at the end, the variations in length of the spring being measured by a special optical system. Other gravimeters are the Thyssen, employing a horizontal lever, weight, and astatizing spring; one consisting of a pair of interconnected vessels containing a liquid, the system being balanced on a knife-edge and made stable by a spring on one of the vessels; the Graf, employing a vertical spring and weight, the variation in position of the weight being measured electrically; the Wright, which uses a tension spring at zero stress when not being read; the Haalk, in which a liquid column is balanced against gas pressure; and the Lindblad, employing a mass supported by curved leaf springs to which are attached condenser plates, the measurements being made by applying an e.m.f. between these and another set of plates. Temperature control and the means of reducing zero drift in these instru-

ments have been improved, as well as the auxiliary apparatus accompanying them. At least two types of gravimeter may be bought from stock.

Watson has modified the Broughton–Edge system, with the result that a solution is obtained which is independent of electrode resistance. Developments in the transient method involve the use of periodic impulses in the current circuit and the attempt to neutralize the transient by a special circuit; the values necessary for this condition are recorded. Continuous profiling technique uses a tractor with spiked wheels to make contact with the ground, the electrodes thus being in motion.

Improvements in the magnetic field balance are a matter of small details. An earth inductor apparatus is being constructed to measure magnetic intensity to less than one gamma. The orientation of cores is now being carried out by magnetic methods.

The Geiger–Müller tube for radioactive work has been improved and a new portable type of apparatus developed. This has been used for measurements in cased boreholes, analogous to electrical logging in uncased holes. Several new systems of electrical coring have been announced. These employ single and double electrodes, instead of the usual three or four, and A.C. is used. One method uses very high frequencies. The resistance elements and the cables in the resistance thermometer used in boreholes have been improved.

Geochemical methods have been restricted to the search for oil and gas. Soil samples or samples of gas collected from a pipe driven in the earth may be used. The analytical methods vary, but all are very complex, due to the exceedingly low concentrations sought. S. E. C.

680. Seismic-electric Effects and New Applications to Seismic Work. A. Belluigi. *Beitr. angew. Geophys.*, 1938, **7** (3), 260–264.—The seismic-electric effect is considered by American authors to be a new electrical phenomenon, and they consider that elastic deformation of a rock results in a momentary change in the electrical conductivity of the rock. This view-point is rejected by German authors, who have carried out much experimental work, and conclude that it is of an electro-chemical nature, and is seated at the contact between the electrodes and earth. If this is the case, the effect should be reproduced in every circuit arranged on the Wenner or some other suitable pattern. Therefore the apparatus used for resistivity surveys can, with the addition of a registering oscillograph, be used as a seismograph. The "electro-elastic" sensitivity of such an apparatus is as yet unknown. If this is sufficient, as may be assumed, then it has the great advantage over all other types of seismographs of not having any moving parts, and the many difficulties due to damping will not arise. S. E. C.

681. Radio Prospecting. VI. Practical Application of the Capacity Method. V. Fritsch. *Beitr. angew. Geophys.*, 1938, **7** (3), 265–280.—In the capacity method the structure to be investigated forms part of the measuring circuit, usually in the antenna circuit. Variations in the natural frequency of the circuit can then be treated as a function of the electrical properties of the structure, and hence of its geological properties. In general, one does not actually measure frequency variations. The frequency of the circuit is kept constant by means of a compensating condenser, and the complex resistance of the geological structure is therefore represented by a capacity. Six basic circuits are discussed and the application of each is indicated. The use of models in illustrating and elucidating certain problems connected with measurements in the field is also discussed. It is shown that a series connection is best for the compensating condenser when searching for a non-conductor in a non-conducting body, whilst a parallel connection is best in the case of conducting bodies. For maximum sensitivity the value of the adjustable part of the measuring circuit should agree approximately with the expected value of the geological conductor being investigated. This amount can be calculated or, in complicated cases, a graphical method may be applied. S. E. C.

682. Magnetization of Geological Bodies. F. Bahnemann. *Beitr. angew. Geophys.*, 1938, **7** (3), 281–284.—The rapid spread of magnetic measurements over greater and greater portions of the earth's surface has yielded an increasing number of results

which can be related with the induction theory only with difficulty or, in many cases, not at all. A number of outstanding cases in South Africa point to mechanical forces playing an important rôle in the magnetization of geological bodies, and the theory that the anomalies are due to a reversal of the earth's field must be rejected. In experimental physics the effect of elastic distortion on magnetization has long been known, and it is now suggested that the anomalies found in the field are the result of shear and strain. S. E. C.

683. Static (Barometric) Gravimeter for Measurements on Land and Sea. H. Haalck. *Beitr. angew. Geophys.*, 1938, **7** (3), 285–316.—The instrument consists of two mercury columns, each of which has a gas-chamber at each end with a difference in pressure of one atmosphere between them. Variations in gravity cause variations in the weights of the mercury columns, and hence in the pressures in the gas-chambers. Measurements of gas pressures therefore give a measure of the variations in gravity. Detailed descriptions are given of the design and construction of the instrument and of the various recording devices which are possible, as well as instructions for the use of the instrument in the field. The scale value can be determined by calculation from the dimensions of the instrument, or it may be found experimentally by tilting the instrument. In connection with the latter method it is shown that errors due to incorrect levelling are negligible, being of the order of 1 mg. per 5 min. of arc. Damping depends, apart from friction, on the dimensions of the connecting tube and capillary and the moment of inertia of the index liquid. It is such that when the instrument is perfectly still one need wait less than a minute before a reading is made. Small movements, however, introduce errors, and hence the accuracy is not so high when working in stormy weather. S. E. C.

684. Graphical Methods for Gravitational Work. F. Breyer. *Beitr. angew. Geophys.*, 1938, **7** (3), 317–336.—The various formulæ which have been published for the purpose of plotting diagrams of gradient, curvature, gravity, deviation of the plumb-line, and potential are collected together in two tables, the first relating to three-dimensional cases and the second to two-dimensional cases. Four different co-ordinate systems are used, rectilinear, cylindrical, conical, and spherical. Tables of the numerical values of the functions entering into the formulæ are also given. Their use is discussed. S. E. C.

685. Geomagnetic Exploration in 1938. N. H. Stearn. *Geophys.*, 1939, **4** (2), 118–122.—Magnetic methods are being used more and more as preliminary to surveys by other methods and to outline regional structural features. A number of examples from the year's work are given to illustrate this. Magnetic surveys have been used for oil prospecting in California, the Mid-Continent, the Gulf Coast, and South Texas. In South Texas they are credited with assisting in the discovery of the Sinton, Plymouth, Heyser, Sweden, and Hoffman pools, but there is not complete agreement on this point. The difficulty lies in the fact that the technique of measuring magnetic anomalies is in advance of interpretation, and other methods have to be employed to determine their meaning. S. E. C.

686. Theory of Seismic Reflection Prospecting. W. H. Tracy. *Petrol. Tech.*, May 1939, **2** (2), A.I.M.M.E. Tech. Pub. 1059, 2–9.—According to the simple theory, a compression wave is created by an explosion and reflected from a stratum back to the surface. The explosion is a transient phenomenon and its efficiency in generating seismic waves is low. Beyond the crushed zone a few thousandths of a second after the explosion is a hollow sphere of rock with the particles in motion outwards and also under pressure (kinetic energy of motion and potential energy of resilience). The short transient wave generated by an explosion differs in many ways from steady-state simple harmonic motion. The wave-train is highly damped, and near the origin the time of passage is probably only $\frac{1}{100}$th of a second.

Most reflections in seismic prospecting are from strata of thickness less than the wave-length of the outgoing wave-train. The character of the reflection is dependent on the thickness of the bed as well as the differences in density and elastic moduli between it and the overlying and underlying adjacent media. Several reflections from

adjacent strata may be analysed, as a single "reflection" or reflections may arise where there is no sharp interface, but only a gradual change. Undoubtedly there are pure interfacial reflections. For small angles of incidence it is believed that at the interface most of the energy is converted into longitudinal reflected and refracted waves. There is reflection with the denser material below and with the denser material above the interface.

The reflection record shows (1) first arrival, (2) direct path compression wave, (3) reflections, (4) ground roll, (5) high-speed ground roll, (6) diffraction waves; but owing to the instrumental characteristics of the receiving and recording apparatus, their true characters are not recorded. The first is used in weathering corrections. The direct-path compression wave should arrive shortly after the fastest wave and have the maximum energy of all the waves. Reflections may have characteristic appearances. The onset may be sudden or gradual. Deep reflections tend to be of lower frequency than shallow. With the average filtered record there is no recognizable ground roll or Rayleigh wave. The frequency of the typical ground roll is 8–15 cycles/sec., as against the usual 25–50 cycles/sec. of reflected waves. G. D. H.

687. Instruments for Reflection Seismograph Prospecting. A. Nomann. *Petrol. Tech.*, May 1939, **2** (2), A.I.M.M.E. Tech. Pub. No. 1059, 9–15.—Geophones or seismometers are actuated by slight earth movements and generate electrical currents, which are amplified and recorded. Their frequencies have ranged 10 to several hundred cycles/sec. Those with a natural frequency of less than, say, 100 cycles/sec. must be well damped to give satisfactory records. A popular type has a natural frequency of 25–50 cycles, and the differential movement in the instrument due to earth movement will tend to have its maximum displacement at the time of maximum velocity of the moving earth. If the natural frequency is high, it should give a very close approximation to a fidelity record of the earth accelerations. However, the intermediate type has the advantage of giving high sensitivity to the range of frequencies which it is desired to record, and the lack of fidelity is more than made up for in the selective action in emphasizing the wanted reflection-wave trains in the record.

Differential movement of the components of a geophone is converted into electrical impulses by a coil moving in a magnetic field, of which the air-gap is varied, by the piezo-electrical properties of crystals or by condenser action.

The character of the signal current from the geophone is more or less modified in the amplifiers. Filtering is used to accentuate the reflections, and can only be applied at the expense of loss of character of the reflections. Filters tend to accentuate oscillations of frequencies between 30 and 50 cycles/sec. Amplification is of the vacuum-tube type in two to four stages. Slight filtering is preferable in correlation methods and severe filtering in dip shooting. In difficult territory geophones are compounded. Most recording systems now include a sensitivity control against time—an expander.

The camera makes a visible record from the amplified signal currents on sensitized paper fed at the rate of 12–18 in./sec. Parallel lines representing $\frac{1}{100}$th sec. intervals are formed on the paper as the record is made. The desired accuracy of at least 1 part in 5000 in the timing lines is attained by using an electrically maintained tuning-fork. Coil and Einthoven string galvanometers are used. The natural frequencies desirable in galvanometers are 50–300 cycles/sec. Those of lower frequency should be critically damped; with the higher frequencies the amount of damping may be less.

Electric blasting caps are now sufficiently uniform in their characteristics for the moment of rupture of the firing circuit within the blasting cap to be considered as the time at which the explosion started. G. D. H.

688. Seismograph Field Operations. H. Ittner. *Petrol. Tech.*, May 1939, **2** (2), A.I.M.M.E. Tech. Pub. No. 1059, 15–21.—Record quality at a particular shot point may vary with relative position of geophones and shot point, shot-hole depth, formations opposite position of shot; size of charge, effect of repeated shots, surface geology and culture in the immediate vicinity of the geophones and recorder instrument characteristics, particularly the filter.

Spread may be basically subdivided into close and open. In the former the geophones are set close to the shot point, and it is expected that the effect of ground roll will have subsided before the reflections to be used reach the surface. A reflection

tends to vary less in character from end to end of a close spread. The practice of using multiple geophones was developed particularly for use with close spread. Instead of a single geophone at each position, a group of two, three, or more geophones is arranged in line towards the shot point. Their spacing is calculated to cancel out the reflection frequency in the ground roll. In all conditions except extremely abrupt variations in thickness of the surface-weathered zone, the reflections will arrive at almost the same time at all the geophones of a group—*i.e.*, the pulses of the reflection will be in phase, and so will be additive for the group. The compound hook-up is a variant of the principle of multiple geophones. The open spread is commonly on one side of the shot point only. All the shallower reflections arrive in advance of the ground roll. Thus a very slightly filtered record may be used to advantage. In dip computation with open spread, the assumed velocities are more critical than with close spread. T and L spreads are also used with the shot point offset from the direction of the line of geophones. The circle spread has been used in special circumstances.

The shot hole should be at least as deep as the top of the " unweathered " zone, and usually a depth of 5–40 ft. within the unweathered zone is desirable. Generally shale beds are preferable to sand opposite the charge.

Record quality usually becomes worse with repeated shots. The character of the surface in the immediate vicinity of a geophone may have a marked effect on the record, and firm, evenly consolidated soil is more satisfactory than loose or sandy soil or swampy areas. Records from geophones on the surface and others directly below at the top of the unweathered zone show little similarity in appearance.

Optical or electrical time parallax between the different recording channels should be particularly guarded against. G. D. H.

689. Determining Geologic Structure from Seismograph Records. P. C. Kelly. *Petrol. Tech.*, May 1939, **2** (2), A.I.M.M.E. Tech. Pub. No. 1059, 22–29.—Marking of the reflections on the records is perhaps the most important step and the one most likely to determine the reliability of the final results. The lack of any definite criteria by which to judge what are good and usable reflections is the main difficulty. Experience is essential with poor records. If the same reflection appears on records from several spread positions, it is called a correlation reflection. If it is unmistakable on the different records, the correlation method should lead to a considerably more accurate map than if the dip method alone is used. If several correlations at fixed time separations can be recognized, the reliance to be placed on each is greater. Correlation methods can show up faulting.

In the computations the first assumption is that the waves travel in straight lines except where reflected, and that at the position of reflection the angle of incidence is equal to the angle of reflection.

Well shooting shows that velocities generally increase with depth. This is due to loading and to previous history, and of course the velocities depend on the type of rock. Qualitatively it suffices to allow only for increase in velocity with depth, but consideration of the stratigraphic effect will give a more accurate picture. Reflections themselves can be used for determining velocities, and if a large number of solutions are made and properly averaged, the velocities should be accurate to possibly 2%.

In dip computation it is assumed that for each spread the source of reflection is a bed which acts as a smooth, unwarped surface in producing the reflection. Actually the energy return considered as a single reflection on the seismogram may be a summation of several reflections from adjacent strata. The several amplitudes and phase relationships will determine the character of the summation. This summation feature renders the computed dip particularly sensitive to variation of reflecting power of any one of the contributing beds.

Weathering corrections must be applied. In some areas a two-layer correction may be necessary. Experiment supports the assumptions that wave velocity is independent of amplitude and frequency.

A straight-line traverse determines only dip components. Where the survey includes a network of intersecting profiles it is geometrically simple to determine the correct position of the surface trace for each bed at the intersection of two profiles. This gives a basis for off-setting the profile lines on the structure map, so that the reflecting beds are shown in their correct position. G. D. H.

690. Gravimeters: Their Relation to Seismometers, Astatization and Calibration. C. A. Heiland. *Amer. Inst. Min. & Metall. Engrs*, Tech. Pub. No. 1049, 1939, pp. 26.—Gravimeters are now closely rivalling the torsion balance in oil-field exploration. The working principles of about a dozen gravimeters are briefly described and treated in relation to the action of corresponding seismometers and astatization methods.

The instruments are detailed and illustrated under two main groups: (1) pneumatometric gravity methods based on variations in gas pressure, as in the Haalck apparatus, and (2) mechanical gravimeters using spring forces, with or without astatization.

Most of the paper is concerned with the more accurate mechanical instruments the sensitivity of which, like that of seismometers, is inversely proportional to the square of their natural frequency. A concluding section discusses the effects of temperature, air pressure, and humidity, methods of determining sensitivity, and means of calibration. D. W.

691. Improvements in Seismic Prospecting in 1938. J. L. Adler. *Geophys.*, 1939, **4** (2), 115–117.—Improvements which give 100% automatic volume control and the compounding of geophone energy have made reflection work possible in country hitherto considered impossible. Typical cases of such terrain are thick, irregular beds of drift overlying rock characterized by a high velocity and, the reverse case, great thicknesses of hard rock near the surface which are underlain by softer rocks. The distribution and spacing of geophones received considerable attention, and the effect of grouping geophones in various geometrical patterns instead of straight lines and arcs was examined. The tendency to extremely close spacing, with its attended disadvantages of increased stray impulses and difficulty in separating reflected and refracted waves, is becoming less. The number of traces per oscillograph is increasing, as many as twenty being used by one company. Although this increases the coverage, care must be taken to ensure that phase changes do not creep in when it exceeds 750–1000 ft. S. E. C.

692. Refraction and Reflection of Seismic Waves. I. Fundamentals. C. H. Dix. *Geophys.*, 1939, **4** (2), 81–101.—The theory of the refraction and reflection of elastic waves is given. The discussion of boundary problems is commenced, and will be continued in a later paper. The subject is considered more from the point of view of the geophysical prospector than from that of the pure seismologist. S. E. C.

693. Seismic-Electric Effect. R. R. Thompson. *Geophys.*, 1939, **4** (2), 102–105.—It has been claimed that the seismic-electric effect is due to polarization at the electrodes, and the question of a change in the resistivity of the earth while it is under the influence of seismic waves has received little attention. Experimental work from this point of view was therefore carried out. Two current electrodes were connected to a storage battery and three potential electrodes to an amplifier with high input impedance. The outer potential electrodes were placed at equipotential points. The current electrodes could be connected either directly with the storage battery or in series with the battery and an inductance coil. Records were taken with the two arrangements, the explosion being as nearly as possible the same in each case. These records were found to be similar, and it is concluded that the effect cannot be due to local variations at the electrode surface. The method used made it impossible to determine whether the effect is due to changes in volume polarization or to changes in resistivity. S. E. C.

694. Development of the State Geophysical Survey of Germany up to the end of 1938. H. Closs and W. Wolff. *Oel u. Kohle*, 1939, **15**, 275–284.—The formation, object, and organization of the State Geophysical Survey are described, together with the methods available and their application. The work accomplished in each year from 1934–5 onward is recorded and maps are given showing the extent to which pendulum, gravimetric, magnetic, seismic, and torsion-balance surveys have been completed during each of the last five years. The results of electrical and radioactive investigations are also recorded, and mention is made of the work of the Geophysical Laboratory in measuring porosity, elasticity, and other properties of samples from borings.

An extensive bibliography is appended giving references of work published in connection with the survey. T. T. D.

695. Gamma-ray Well Logging. L. G. Howell and A. Frosch. *Geophys.*, 1939, **4** (2), 106–114.—This method was developed in an attempt to solve the problem of logging in cased holes. In addition, it was hoped that the alleged high radioactivity of oil would simplify the location of oil sands. An apparatus employing an ionization chamber containing nitrogen at 500 lb./sq. in. gave records in uncased holes which compared favourably with the normal electrical logs. A more robust type of instrument, employing two Geiger counters, each with its own amplifier and frequency meter, was then designed. With this a continuous record could be made at a speed of 25 ft. per minute. This instrument, when used in both cased and uncased holes, gave records remarkably well in accord with the electrical logs for the wells. No evidence was found of high radioactivity in oil sands. S. E. C.

Aerial Survey.

696. Photogrammetric Mapping and Geological Exploration from the Air. O. I. Bracaccini. Report on a Meeting at Norman, Oklahoma, U.S.A. *Bol. Inform. Petroleras*, February 1939, **16** (174), 43–45.—Eight papers read are referred to, and particular attention is directed to Nos. 1, 6, and 7, which bear directly on the problem of geological exploration. H. I. L.

Drilling.

697. Automatic Geolograph Correlates Drilling Speed with other Pertinent Data. B. Mills. *Oil Wkly*, 10.4.39, **93** (5), 11.—A recent innovation has made it possible to record automatically the speed of drilling on a time chart, together with such information as round trips, circulating time, shut-down time, etc. Complete foot-by-foot drilling time records are a graphic presentation of the speed with which formations can be drilled under given conditions, such as weight on the bit, condition of hole, and of the mud fluid.

An apparatus has been developed which records automatically the drilling depth and rate, and the drilling operations simultaneously in parallel columns on a chart which is turned by a clock.

A description of the apparatus and an interpretation of a chart are given.

L. V. W. C.

698. Directional Drilling Prorates Cost of Expensive Derrick Foundation. B. Mills. *Oil Wkly*, 10.4.39, **93** (5), 14.—The use of directional drilling has effected a considerable saving in location expenditure, since from three to nine wells may be drilled from a single pier combination. The pier arrangement enables the derrick to be skidded a short distance, the shift placing the wells from 24 to 34 ft. apart at the surface. In swampy areas one road serves the entire group of wells, whilst at water locations the island for four or six wells may be constructed at a much smaller cost than for four or six separate piers.

The skidding of a derrick only its base width permits the use of a common pier foundation for two wells.

The first well is usually completed as a straight hole, and subsequent wells have been drilled from group arrangements, and have been deviated for completion at a desired point in the producing formation. L. V. W. C.

699. Well Completion Data. S. F. Bowley. *Oil Wkly*, 27.3.39, **93** (3), 17.—Improvements in drilling and completion technique, as well as the introduction of electrical measuring devices, have increased the degree of accuracy and correlation in order to be of maximum use and profit, particularly with the greater depths to which exploration is now carried. The types of data which are required for the most economical development of a field according to the most recent advances in technique are presented. The manner in which such data may be recorded graphically in order that they may have the greatest utility is illustrated, and usability is stressed in keeping the records and in assembling data. L. V. W. C.

700. Rearrangement of Slush Pits Cut Mud Costs. C. Johnston. *Oil Wkly*, 3.4.39, **93** (4), 20.—The Delta Drilling Co. is completing a number of wells in the Arkansas

area with a minimum of mud expense, despite the penetration of a highly abrasive thick shale section. A rearrangement of the slush pits which permits it to save mud that is in good condition and reject the laden fluid has enabled this to be accomplished.

The quantity of mud is built up until the shale section is reached at 3800 ft. By this time there is usually ample mud on hand to cover the needs for the remainder of the hole. To cut down mud loss and yet be able to reject the shale laden mud the conventional lay-out of mud pits is discarded.

A sketch and description of the lay-out are given. L. V. W. C.

701. Gravel Packing 6400 ft. Southern Louisiana Flowing Wells. F. N. Brasher. *Oil Wkly*, 10.4.39, **93** (5), 22.—Gravel packing has been successfully used in the University field near Baton Range, Louisiana, where the producing horizon is an extremely fine and unconsolidated sand. Difficulty is experienced in maintaining profitable production in this formation.

The gravel packing of the wells is done by placing the gravel with a patented hydraulic method. After the 7-in. casing has been set and cemented, the productive formation is under-reamed to 16 in. diameter. Then screen liner and packer are made up and lowered to bottom on tubing. The gravel equipment, consisting of high-pressure drums, pumps, control valves, etc., mounted on a truck, is then connected to one of the side outlets in the casing. The gravel is then mixed with water and circulated and deposited by reverse circulation in the annular space between the screen and the wall of the hole. L. V. W. C.

702. Steam Efficiency Attained on Four-Engine Powered Rig. B. Mills. *Oil Wkly*, 27.3.39, **93** (3), 32.—Efficient utilization of steam power has been an important factor in Gulf Oil Corporation's barge drilling programme along the Louisiana Gulf Coast. Added flexibility is obtained by the use of four steam engines, while a heat-conservation programme has materially reduced fuel oil and water consumption. The difficult conditions demand heavy steel drilling and boiler barges, and both barges are of the submersible type. When the barges are sunk to rest on the lake bottom, they become derrick and boiler foundations.

The rotary table is driven by a separate steam engine, the engine and table being mounted on a single base. A two-speed gear box is attached to the frame of the engine. The two slush pumps are driven by separate vertical engines, which are each capable of developing adequate horse-power with about half the steam required in direct-acting steam pumps. A further vertical-type engine drives the hoisting gear. L. V. W. C.

703. Casing Used as Drill Pipe to Overcome Heaving Shale. K. C. Sclater. *Petrol. Engr*, February 1939, **10** (5), 25.—A successful experiment was carried out in the Louisiana field which enabled a string of casing to be landed and cemented through a troublesome body of heaving shale.

The hole had been drilled with 4½-in. drill pipe to 8160 ft. with open hole from 6295 ft. below the 10¾-in. shoe. Between 8133 ft. and 8150 ft. heaving shale was encountered. The hole would fill with shale to about 7900 ft., causing the circulation to be lost and the drill pipe to stick.

It was decided to set the casing by rotating through the shale. Before pulling the drill pipe the mud was thoroughly conditioned to a depth of 7900 ft. The casing, equipped with a cast-iron shale bit, was then run into the hole. No float equipment was used in the casing string, but the bottom ten joints of casing were welded as a precaution against backing out. The casing was run to 7790 ft., at which depth circulation was established, mud reconditioned, and the casing rotated.

A special device was rigged up to allow the casing to be rotated and at the same time to be worked up and down. A picture of this is given.

Great care was taken when the heaving shale was met, and the last length of casing was lowered very slowly, at about 15 ft./hr. to 8165 ft. The casing was then cemented. L. V. W. C.

704. Measurement of Load on Cable during Cable-tool Drilling. G. S. Peterson. *Petrol. Engr*, February 1939, **10** (5), 33.—The author describes the weighing of cable

loads by a Kembler Well Weigher during the drilling of a well in Pennsylvania, and discusses the nature of the data obtained.

The weigher consists primarily of a magnetic strain gauge and photographic recording equipment. The gauge is mounted between the cable hitch and the temper screw in such a way as to support the total cable load in compression.

Strain versus stroke diagrams were taken on the well at three different drilling speeds with normal hitch and a loose hitch. Typical cards are given. A study of the card diagram shows, in general, the change in magnitude of the maximum and minimum cable loads, together with change in load resulting from the tool striking the formation. Also a comparison of several of the cards shows in general the effect of a change in hitch. L. V. W. C.

705. Economies Result from Use of Drill-pipe Protectors in Drilling Open Hole. W. A. Sawdon. *Petrol. Engr*, February 1939, **10** (5), 44.—The use of drill-pipe protectors to protect the casing in which the drill pipe is rotating has been standard practice. Recently study has been given to the possible value of protectors on drill pipe in open hole both for wear on tool joints and whipping.

The tests were carried out in the Coalinga Nose district, and were started at a depth of 5214 ft. and completed at 7324 ft., 1209 ft. of drill pipe being equipped with protectors. The 1209 ft. of protected drill pipe extended from 2604 ft. to 3813 ft. above the bottom of the drill string, leaving 781 ft. of unprotected pipe in open hole above the protectors at the start of the test and 2891 ft. at the finish.

The results of the test are shown graphically, and indicate clearly the value of the use of protectors. L. V. W. C.

706. Heavy Duty Surface Equipment for Deep Drilling being Tested in California. W. A. Sawdon. *Petrol. Engr*, March 1939, **10** (6), 25.—Some of the heaviest surface equipment ever used for rotary drilling has been installed in the Rio Bravo Field, California. Steam at a pressure of 500 lb. is used in the draw-works engine and slush pumps. The steam generating plant is one of the outstanding features of the installation. A battery of five Broderick domeless boilers supplies the steam. These boilers have a rating of 130 h.p., and the superheater is built integral with the boiler. The feed-pumps and turbo-generators are mounted as one unit on one base. The draw-works engine is rated at approximately 1700 h.p. Large crown and travelling blocks are used. The crown block equipped with 6–48-in. sheaves, and the travelling block provided with 5–48-in. sheaves will carry the 1¼-in. line being used for drilling. The draw-works is equipped with a hydromatic brake. L. V. W. C.

707. Use of Oil-well Cement containing Prepared Bentonite. W. A. Sawdon. *Petrol. Engr*, March 1939, **10** (6), 33.—Cement is given a high angle of repose and is prevented from dissipation into crevices or fissures by the gelling property imparted to it by the addition of prepared bentonite. The density of the cement is increased by the addition of 1–4% of bentonite, and permeability, dilution, and shrinkage are simultaneously decreased. Where a squeeze job is undertaken, such an addition forms a product which is specially adapted.

The shutting-off of water in the East Texas Field just below the producing zone is frequently a difficult operation. The use of gel-cement—the name given to the treated cement—has provided the means for applying the squeeze necessary to form a successful plug.

A number of jobs are described. L. V. W. C.

708. Small Holes Lower Cost of Exploration. B. Mills. *Oil Wkly*, 6.3.39, **92** (13), 35.—Small-hole drilling has become an accepted exploratory medium in both deep and shallow producing areas. This drilling should not be considered a cure for all development evils, and where cementing requirements are exact, production is deep, and drilling conditions are severe, small hole drilling may not be effective.

The cost of drilling the small holes varies from $1.5 to $3.0 per foot for the 5000–8000-ft. wells.

The size of hole below the surface casing varies, but where the well is drilled as an oil well, and not as an exploratory one, 8¾ in. to about 7000 ft. has been satisfactory.

The bit cost in small hole drilling is about 5% of the total cost, and the mud cost has been even less in several wells.

The equipment best suited is the light rotary outfit that offers a full margin of safety, high portability, and ease of assembly. L. V. W. C.

709. Large Group of Wells to be Directionally Drilled at Huntington Beach. J. C. Albright. *Petrol. Engr*, March 1939, **10** (6), 65.—The South-west Exploration Company commenced the drilling of eighty-seven slant holes along the Huntington Beach in November 1938.

An engineer is always on duty so that the drill pipe may be oriented into the hole when a whipstock or other tool is being set to control the deflection of the hole from the vertical. Single shot surveys are carried out at intervals of less than 100 ft., and the acuteness of the angle of deflection is controlled by the weight on the bit and by the speed of rotation, after the direction has been established by the whipstock. A clinograph is used frequently to check the direction and angle as measured by the open-hole and inside single shot.

The plan includes three rows of wells, the first row bottomed nearest the shore line, and the other two spaced farther out beneath the ocean. The drilling rigs will be moved progressively westward until twenty-nine wells have been drilled if the zone is not defined earlier. After the first row has been drilled, the tools will be moved to the starting point, and the next row started.

A central boiler battery of two units of three boilers each is included, and a series of piers supports the main steam distribution header and all service piping. A central mud pit was excavated and a central pit was maintained for disposal of shale and other cuttings. A central battery of oil/gas separators and flow tanks was built to be supplemented with others as drilling progresses. L. V. W. C.

710. Illinois Basin Section. H. Lee Flood. *Petrol. Engr*, March 1939, **10** (6), 74–140.—This section deals with the activities of the Illinois basin, covering such questions as the drilling and completion methods in the Salem field, where the trend is towards decrease in weight and size of equipment, and where small-hole drilling gains in favour, and the refining facilities available for processing oil from these fields. The drilling and completion practices in the Louden field where welding of casing and gel-cement and soluble alloy sections of the casing are used extensively are considered. Pipe-line loops and new stations have increased capacity of old lines, and some new lines have been laid. In the new Illinois fields central power and unit pumping are about equally satisfactory, whilst paraffin problems and salt-water disposal have been economically solved. Excess gas is returned to the sands in the Salem and Louden fields, and the rate of pressure decline has been greatly reduced as a result. The roads in the fields impose extra burdens on the transport, and the standard equipment has been modified and special equipment developed to overcome these conditions. L. V. W. C.

711. Drilling Patents. M. Hokanson. U.S.P. 2,145,262, 31.1.39. Appl. 22.4.37. Drill rod and bit joint.

R. B. Kinzbach. U.S.P. 2,145,433, 31.1.39. Appl. 25.7.36. Whipstock anchor.

J. H. Hudson and H. G. Hudson. U.S.P. 2,145,512, 31.1.39. Appl. 22.6.38. Setting and cementing tool.

N. Johnston. U.S.P. 2,146,262, 7.2.39. Appl. 31.5.38. Method of coring by elevating the temperature of the circulating fluid in the well above its normal drilling temperature, introducing into the well a metal fusible at the elevated temperature, forming a core at the bottom of the hole and below the molten metal. Then lowering the temperature of the fluid below the solidifying point of the metal, thereby sealing the core within the barrel.

W. N. Sutcliff. U.S.P. 2,146,454, 17.2.39. Appl. 15.6.35. Vibrating well jar.

E. M. Grandfield. U.S.P. 2,147,436, 14.2.39. Appl. 10.3.37. Shock absorber for cable-drilling machines.

F. J. Hinderliter. U.S.P. 2,147,254, 14.2.39. Appl. 15.7.35. Rotary tool joint.

G. F. Le Bas. U.S.P. 2,147,491, 14.2.39. Appl. 4.12.36. Side tracking device having knuckle joint.

G. A. Lowrey. U.S.P. 2,147,537, 14.2.39. Appl. 22.8.36. Method of side-tracking a well bore, which consists of completely removing a section of the casing to provide open hole, setting a deflector and lowering the drilling tools until they are deflected.

E. L. Potts. U.S.P. 2,147,544, 14.2.39. Appl. 29.9.38. Orienting sub, combination of a drill stem, a drill sub and a drill collar connected to the sub. A non-magnetic sleeve is disposed in a recess in the sub and a permanent magnet carried by the sub. Means on the pipe and sleeve to indicate after assembly the position of the magnet in the sub.

O. B. Trotter. U.S.P. 2,147,585, 14.2.39. Appl. 29.6.37. Whipstock having tapered portion and a string of drill pipe with bit attached. A ball-and-socket joint is disposed in the drill pipe to provide angular movement of the bit, and means on the stem to engage a locking ring for rigidly supporting the whipstock while the latter is lowered or raised in the hole.

F. L. Scott. U.S.P. 2,147,926, 21.2.39. Appl. 7.12.36. Four-core drilling-bit.

F. L. Scott. U.S.P. 2,147,927, 21.2.39. Appl. 30.4.37. Core-cutter support.

M. B. Graham. U.S.P. 2,148,019, 21.2.39. Appl. 26.7.37. A fishing tool comprising a housing for attachment to the drill pipe and a basket having means for opening or closing the lower end as the tool is operated in the well.

L. E. Garfield. U.S.P. 2,148,372, 21.2.39. Appl. 21.3.36. Offset tricone bit.

L. E. Garfield. U.S.P. 2,148,373, 21.2.39. Appl. 19.6.36. Retractable core barrel.

C. C. Brown. U.S.P. 2,149,417, 7.3.39. Appl. 9.3.36. Means for removing pipe from wells.

L. V. W. C.

Production.

712. Some Factors in Oil Accumulation. V. C. Illing. *J. Inst. Petrol.*, 1939, **25**, 201–229.—A paper with discussion on the influence of texture and buoyancy in the flow of oil and water mixtures through sands and its bearing on oil accumulation.

G. R. N.

713. New Device for Determining Porosity by the Gas-expansion Method. A. B. Stevens. *Petrol. Tech.*, May 1939, **2** (2), A.I.M.M.E. Tech. Pub. No. 1061, 1–5.—In the Washburn–Bunting method contact of the specimen with mercury when under high vacuum allows mercury to enter the pores, making it impossible to use it for check determinations or for a further test such as permeability.

The apparatus consists of an expansion chamber on the top of which is a capillary tube graduated in 0·05 ml. divisions and having a stopcock at the top. To the bottom a mercury reservoir is attached by rubber tubing, with a short length of glass tubing bearing a reference mark immediately below the expansion chamber. On the side of the expansion chamber is the core chamber, closed by a screw cap and separated from the expansion chamber by a stopcock. With the specimen in the core chamber and the core-chamber stopcock closed, all the air is driven out of the expansion chamber and calibrated tube by raising the mercury to the top of the latter, and then lowering it after closing the stopcock at the top of the calibrated tube. The mercury is then lowered to the reference mark. The air in the core chamber is allowed to expand into the expansion chamber, and when equilibrium has been attained, the core chamber is cut off and the mercury reservoir raised until the mercury in the reservoir and graduated tube are at the same level. The volume of air is read, and after expul-

sion of this air, the process is repeated, more air being allowed to expand from the core chamber. The volume is again read and added to the first figure.

$$P = 100\,\frac{V_b - (V_c - V_r)}{V_b}$$

P is percentage of effective porosity ; V_b is bulk volume of sample ; V_c is volume of core chamber ; V_r is sum of readings in graduated tube. The bulk volume of the specimen is determined by mercury displacement, and the volume of the core chamber by the use of solid specimens of known volume. G. D. H.

714. Well-condition Analysis Aids Pumping Equipment Solution. H. F. Breadmore. *Oil Wkly*, 3.4.39, **93** (4), 15.—The data obtained from well studies prior to pumping may be applied to equipment selection. Field tests are important when the region does not have other fields for comparison, and they show energy in reservoir, flow characteristics, capacity of wells to produce and presence or possibility of cavings, corrosion, water, gas, etc.

An active water drive is indicated if the formation pressure declines some amount and then fails to decline farther at a constant rate of withdrawal over a period of months or years. If increased withdrawal starts more pressure decline, the indications are of an active water drive. A gas-drive field is indicated when a somewhat constant rate of pressure decline occurs for each unit of fluid removed from the reservoir.

Flow tests measure the capacity of the well against varied back pressures, and are computed into a figure called the productivity index of the well. The index is commonly expressed as barrels per day of gross liquid produced per pound per square inch drop in pressure at a specified subsurface datum. L. V. W. C.

715. Fitting the Pumps to Well Conditions. E. A. Jenkins. *Oil Wkly*, 10.4.39, **93** (5), 36.—If the well's allowable is to be produced economically, it is evident that the pump best fitted to a well is the one to be selected.

If the pumping jack, unit, or front is of conventional design, there are three variables to be used in selecting the pump ; (1) length of stroke ; (2) number of strokes, and (3) bore of the pump.

The selection of the surface equipment is influenced by many of the factors that enter into the selection of the pump.

A number of factors having some bearing on the pump to be used are given in the article, together with a sucker-rod load chart, the use of which is explained.

L. V. W. C.

716. Practical Water-flooding Efficiency in Oil Production. H. M. Ryder. *Oil Wkly*, 24.4.39, **93** (7), 51.—Flooding operations must be carried out on an efficient basis if the increased costs for labour, etc., are to be balanced. Only by competently fitting the development plan and operating procedure to the sand conditions as they exist can efficiency be obtained.

For each property there is one best drilling pattern, well spacing and pressure, and no one best plan for all properties. Sand characteristics vary greatly in any one property, not only from the top to the bottom of the sand, but also laterally from well to well. These variations must be compensated for, and can be by shooting according to conditions individually found.

Only by giving the strictest attention to each individual operation to the sand conditions in each property and in each well can the most oil be obtained at the lowest unit cost. L. V. W. C.

717. Selection of Back-side Pumping Equipment. K. N. Mills. *Oil Wkly*, 1.5.39, **93** (8), 15.—Back-side pumping has expanded from a pumping system used on relatively shallow wells to a practical method for pumping medium-volume deep wells.

A torque diagram will show that the reducer load factor in back-side pumping is a function of the number of wells being pumped from the reducer, and also that when wells of equal weight are being pumped with equal lengths of stroke, a reducer that

has sufficient capacity to pump two wells will be capable of pumping four such wells if they are connected to two opposing cranks and the phase relationship of the cranks is correct.

Torque diagrams for a four- and three-well hook-up are given, together with the formulæ for finding amount of counterbalance effect and the maximum overhung load. L. V. W. C.

718. Locating and Counterbalancing Central Powers Involves Many Variables. B. Altman. *Oil Wkly*, 8.5.39, **93** (9), 13.—The location of any central power must be satisfactory with regard to topography as well as with respect to counterbalancing.

A simple method for selecting a site for the power is to lay out the lease to scale on cardboard and to punch holes in the board for the various wells. Strings should then be run through the holes and all tied together above the cardboard. Weights should then be attached to the lower ends of the strings, the weights being in proportion to the weights of the wells as obtained by a dynamometer. The settling point at which all the strings are tied together will approximate the best location for the power.

Each well to be connected to the central power must be weighted with a dynamometer to determine the amount of h.p. required, as well as the maximum loads which are apt to be encountered. Total h.p. required at the power crank is the sum of the measured h.p. plus the friction h.p.

A recording tachometer may be used to determine the effect of a dummy or counterbalance.

Graphs are given showing composite torque load curves with all wells on, rod-line friction horse-power *v.* rod-line travel in inches per minute, horse-power required *v.* rod-line travel, etc. L. V. W. C.

719. Bottom-hole Measurements in Pumping Wells. J. J. Jakosky. *Petrol. Tech.*, May 1939, **2** (2), A.I.M.M.E. Tech. Pub. No. 1058, 1–23.—One of the most important measurements in production studies is that of the bottom-hole pressure at various rates of production. This may be done directly by bottom-hole pressure gauges or by measuring the fluid-level height and the density of the fluid. Bottom-hole pressure-gauges are now usually of a self-contained, continuous recording design, and are fastened below the pump. This involves pulling the pump, and possibly the tubing, twice, in order to get a record. Hence the method has certain drawbacks.

Measuring-line methods of finding fluid levels are generally not suitable during pumping operations. The most successful methods of finding fluid levels in pumping wells or wells under pressure utilize sonic or wave-reflection principles. Two methods have been applied commercially: (1) a pressure-impulse method which employs a subaudio-frequency pressure impulse created by the release of compressed gas from a tank and (2) the selected frequency steep-front wave method, which uses waves initiated by a cartridge. Details of the Echo-Meter are given.

As the sound wave travels down the annular area or opening between the tubing and the casing, it is gradually absorbed and partly reflected by practically all obstructions which change the effective area or opening between the tubing and the casing. Small reflections are generated by tubing collars, whilst tubing-catchers and liner-tops usually send back much stronger reflections. The fluid surface sends back practically the whole of the wave front which has reached the bottom of the well. These various reflections are recorded, and permit the determination of the required depths. The wave velocity depends on the temperature and composition of the gas in the well. This is determined by a calibration test. Corrections have to be applied for the high initial velocity of the gas.

An example is given of a depth determination with the Echo-Meter. In applying the density factor for the oil in the well the question of oil separation must be considered. Costs, the determination of pumping rates and efficiencies, and formation pressures are discussed. G. D. H.

720. Exploring Drill Holes by Sample-Taking Bullets. E. G. Leonardon and D. C. McCann. *Petrol. Tech.*, May 1939, **2** (2), A.I.M.M.E. Tech. Pub. No. 1062, 1–13.—Because of time and expense, core drilling cannot be used for the entire length of a drill

hole. Admittedly the cuttings brought to the surface by the mud give interesting data, but the only reasonably easily obtained continuous record of the formations encountered is that furnished by electrical surveys. It would be preferable to make the electrical survey first, and then sample the walls of the hole according to the indications of the electrical log. In this way it is possible to core only the exact sections required, eliminating the otherwise inevitable estimates as to the point at which to start coring, and thereby reducing to a minimum this expensive operation. A device for taking samples of the formations from the wall of the hole therefore offers the possibility of recovering cores from zones otherwise lost as a source of this type of information.

The side-wall sample-taker is lowered into the hole on the cable used for electrical logging, electrodes being placed on the cable in the usual manner with the sample-taker a fixed distance away. Thus the sample-taker can be set according to the log alone. The bullet sample-taker is an open, hollow cylinder which is fired into the formation and, being attached to the apparatus by a cable, is capable of being withdrawn. By multiple mounting as many as eighteen cores can be obtained from different horizons in a trip of about 3 hr.

The cores are $\frac{3}{4}$ in. diameter, and $1\frac{1}{2}$–$2\frac{1}{2}$ in. long. They are not compacted or crushed. Side-wall sample-taking has shown that while invasion of the porous formations by drilling mud occurs, a true oil sand retains much of its oil, even very near the hole, and a salt-water sand retains much of its salt. The core recovery is about 70%, and only 2% of the bullets are lost.

At present the usual object of a sampling operation is the verification of oil, gas, and water zones as indicated by electrical resistivity. In the laboratory salinity, porosity, permeability, and colloid or organic content of the cores may be determined. Examples of such observations are given. G. D. H.

721. Condensate Wells. Completion and Recycling Operations. E. V. Foran and P. C. Dixon. *Oil Wkly*, 20.3.39, **93** (2), 17.—The occurrence of deep-condensate-type producing horizons gives the industry an opportunity for a study of the application of new methods of development and practice that may enable more efficient recoveries of the reservoir products to be made. At the time the reservoir is discovered its products exist entirely as a stable gas, and became unstable only under declining pressure. When this occurs, it is observed that a portion of the reservoir gas products condense and liquids become unrecoverable. By a maintenance of initial reservoir pressure all the products can be produced without condensation taking place within the reservoir, thus permitting recoveries probably as high as 90% of the total reservoir content, with one-tenth of the number of wells required for drainage under conventional operations. L. V. W. C.

722. Pressure Maintenance for Economic Distillate Structure Production Essential. H. N. Wade. *Oil Wkly*, 27.3.39, **93** (3), 25.—Studies have been made of the economics of so-called distillate well production during the past year. These studies have resulted in the design and construction of one production and pressure-maintenance unit processing 50 million ft. per day of gas and producing 45,000 gal. per day of distillate.

The structures tested are all comparatively small, oval-shaped, closed domes, and in every case there are numerous productive sands.

It is definitely established that all hydrocarbon materials in a distillate structure are in a vaporous or gaseous state.

The method of production which has been in wide use in the Gulf Coast is to pass the gas to a conventional separator held at say 600 lb. pressure. Upon cooling and partial release of pressure, part of the heavier hydrocarbons condense and separate from the gas. The efficiency of this single method of production can be improved by applying artificial cooling in addition to the natural cooling through the well tubing. This cooling can be done in various ways, such as by cooling coils in an atmospheric cooling tower, etc.

The tests have proved that fair efficiencies of extraction can be attained by cooling and expansion to some moderate pressure, say in the range of from 800–1200 lb. in the separator. It is essential, however, that the stripped gas be returned to the pro-

ducing formation. The separator pressure must therefore be kept as high as possible. If the distillate sand is produced under usual oil-field conditions, without returning the dry gas to the sand, the pressure on the sand will decline and condensation will start.
L. V. W. C.

723. Gas-Distillate Production in South Texas. E. S. Post. *Refiner*, 1939, **18**, 80.—In the South Texas Gulf Coast there are several deep fields producing at high gas/oil ratios, and under present rulings wells must be shut in unless there is a market for residue gas. By practising high-pressure gas recirculation to the sands, it has been possible to recover premium natural gasoline or gas condensate, at the same time maintaining the pressure and stimulating recovery of liquid. A short survey, with tables, of this area is given.
G. R. N.

724. Wild Well Quickly Subdued. B. Smith. *Petrol. Engr*, February 1939, **10** (5), 128.—Modern methods of fighting wild wells was demonstrated when a Texas well blew out and ran wild from a depth of 3000 ft. while preparations were being made for a production test.

By the time the well-fighting crew arrived the entire derrick was threatened with destruction. A truck was backed to the derrick floor and a 10-ton manifold was dropped into the open casing, all valves being open.

The tapered manifold was forced into the casing-head and heavy cables and turn buckles were used to effect a gas-tight seal. The main control valve on the manifold was just above the derrick floor. When the manifold was safely tied into the casing-head, this valve was closed and the well was once more under control. L. V. W. C.

725. Exploiting Stray Sands in Stripper Fields. F. R. Cozzens. *Petrol. Engr*, April 1939, **10** (7), 78.—Many sands have, in the past, been cased off, and only when the major sand has been exhausted have attempts been made to exploit these sands.

In reclaiming a stray sand, as these sands are called, the pumping equipment is pulled and the hole is plugged with cement to about 10 ft. below the sand to be treated. A nitroglycerine charge is then exploded opposite the sand. Before caving starts, a pipe-line is placed over the hole and the reservoir made by the blast is completely filled with crude oil. Casing is then sealed and the well capped and allowed to remain for 30–60 days.

The crude oil placed in the reservoir may, and often does, soften the sludge and penetrate into the rock for a considerable distance.

When no log of the well has been kept, it is usually necessary to ream the hole to the top of the sand, leaving a shoulder for the casing seat.

The presence of a sand may be determined without re-drilling by plugging as for shooting and then introducing a pressure of from 300 to 500 lb., which should be maintained for several days. If air bubbles appear outside the casing of other wells in the vicinity, it is an indication of the presence of that sand in those wells.
L. V. W. C.

726. Test Well in Eastern Peru Successfully Completed. W. A. Sawdon. *Petrol. Engr*, April 1939, **10** (7), 33.—A production area in the Andes Mountains has recently been discovered by the completion of a discovery well. The location is 2 miles from Pachitea River, and is approximately 700 ft. above the river. The road from the river to the site is 6 miles long, and over this road all the equipment and supplies, which had been brought by river-boats more than 3000 miles from Para, Brazil, were hauled.

The discovery-well was the second well drilled. It was drilled to a depth of 1174 ft., and when put on production produced 750 brl. per day through a ½-in. choke for 7 days and 1000 brl. per day through a 40/64-in. choke for 1¼ days. Through open tubing the well produced 100 brl. per day. The gravity of the oil is 45° A.P.I. L. V. W. C.

727. Perforated Liner is Gravel-packed Before Being Placed in Well. W. A. Sawdon. *Petrol. Engr*, April 1939, **10** (7), 42.—Gravel-packing through the producing zone has proved advantageous in the Wilmington field in California, but, unfortunately, the wells in this field produce from more than one zone, and the formations between the producing zones must be cemented off. It has been possible, therefore, to gravel-

pack only one zone in any one well. By encasing the liner with gravel before it is run, this difficulty has definitely been overcome.

The construction of the gravel-encased liner is clearly shown in a sketch. On a 6¼-in. slotted liner the gravel encasing is 1 in. thick. The gravel is held in place around the pipe by a heavy screen, the mesh of which is just small enough to hold the smallest grains of gravel.

Several advantages are claimed for the prepacked liner over the normal method of gravel-packing. L. V. W. C.

728. Acid Solvents for Oil Wells. L. C. Chamberlain and R. F. Boyer. *Industr. Engng Chem.*, 1939, **31** (4), 400.—Laboratory and field data are presented to illustrate those chemical and physical properties of acidizing solutions which affect their attack on metallic parts of the well, their flow into and reaction on the porous rock, the formation of emulsions and secondary precipitates, their return from the well, and their subsequent separation from the produced oil.

Attention is given to reaction rates as applied to determining the distance which acid travels in pores before spending itself, and the resultant shape of the pore after acidizing. For a capillary sufficiently long so that the flow of acid through it remains substantially constant during treatment, the normality of the acid after travelling a distance L is given by

$$N = N_0 e^{-\frac{20\pi\rho SL}{\phi}}$$

where N_0 = original normality,
ρ = density of limestone,
ϕ = flow rate c.c. per minute,
$S = b/N_0$, where b is slope of r^2 versus t curve,
t = time seconds, and
r = capillary radius.

The data given, taken in conjunction with calculations on the optimum distribution of permeability near a well face, lead to a method for choosing the acid which is very desirable for field conditions. H. E. T.

729. Deep Pumping in Oil-field Operation. Deicher. *Petrol. Z.*, 1938, **34** (35), 7–12.—The gas-to-oil ratio in the crude being pumped has a great influence on power waste. The gas content may be controlled by choice of capacity and stroke of pumps, by adjustment of pump depth, and by increasing the back pressure in the efflux line.

The properties of the oil-sand and the viscosity of the oil determine the most advantageous clearances to be used in pumps. The author suggests extension of the present A.P.I. standard over-size gauges for pump pistons to embrace four over-size and four under-size pistons, with a corresponding range in cylinder sizes. This would permit eight re-grindings of piston and cylinder before discarding.

Since the stresses on pump rods and tubing are always in opposite phase, the strains produced are additive, and combine to reduce the stroke of the pump. This reduction must be allowed for in power-efficiency calculation, and has been evaluated experimentally for various depths and dimensions of pumping equipment.

Maximum pumping efficiency combined with minimum strain on pump foundations is attained by use of pump-rods of composite diameter.

Nomograms are given for determination of production, power efficiency, and lift required at various depths and with various dimensions of equipment, and for calculation of dimensions of composite pump-rods for various pump depths, maintaining a given safety factor. C. G. G.

730. Physical Properties of Hydrocarbons and their Mixtures. E. R. Gilliland, R. V. Lukes and H. W. Scheeline. *Petrol. Tech.*, May 1939, **2** (2), A.I.M.M.E. Tech. Pub. No. 1060, 1–16.—Knowledge of a large number of the physical properties of hydrocarbons is needed in the calculations and studies of production engineering. In numerous operations in the petroleum industry vapour and liquid phases are encountered in contact with each other. For the calculations relating to such operations it is frequently necessary to be able to estimate or predict the relative composition of the two phases. The so-called equilibrium still has been modified for use under high

pressures, and the data for propane–*iso*butylene mixtures are described and compared with the predictions from fugacities.

The effect of pressure on the enthalpy of hydrocarbon vapours can be fairly large, particularly at high pressures. Apparatus is described for the measurement of the isothermal enthalpy change for the isothermal expansion from a high pressure to substantially atmospheric pressure. Measurements were made on benzene and have been compared with the calculations based on pressure–volume–temperature data available for other hydrocarbons. It is concluded that the enthalpy changes when correlated on the basis employed in this paper are not greatly affected by the organic series to which the hydrocarbon belongs. G. D. H.

731. Production Patents. E. Alzner. U.S.P. 2,145,231, 31.1.39. Appl. 17.9.37. Gun perforator using an explosive gas contained within the perforator and igniting the gas to explode the solid explosive charge.

C. C. Brown. U.S.P. 2,145,844, 7.2.39. Appl. 1.9.36. Well-head structure having retractable tubing section.

A. L. Leman. U.S.P. 2,145,884, 7.2.39. Appl. 30.1.36. Flexible tubing stripper for effecting a fluid-type seal between the well-head and the tubing.

I. E. Bryan. U.S.P. 2,145,918, 7.2.39. Appl. 21.12.36. Gas-lift apparatus.

G. S. Knox. U.S.P. 2,146,219, 7.2.39. Appl. 6.6.37. Well-pipe plug comprising a body, a vertically moving sleeve, wedge slips mounted in the body and expansible by movement of the sleeve to prevent downward movement of the plug. Means to move the sleeve in a direction to expand slips.

L. R. Underwood. U.S.P. 2,146,363, 7.2.39. Appl. 30.4.38. Paraffin scraper.

R. A. Wilson. U.S.P. 2,147,072, 14.2.39. Appl. 13.11.34. Well swab.

C. J. Coberly. U.S.P. 2,147,766, 21.2.39. Appl. 21.4.37. Fluid-operated pump-piston device.

G. G. Harrington. U.S.P. 2,147,896, 21.2.39. Appl. 27.8.37. Sample-taking device having valve-means to prevent outward flow through the upper end of the core barrel and means for sealing the lower end of the barrel, this means being movable upwards during the taking of the core.

H. M. Salentine. U.S.P. 2,147,924, 21.2.39. Appl. 8.11.35. A well-pump mechanically connected to an hydraulic reciprocator and both parts located in the well.

B. E. Lindsly. U.S.P. 2,147,983, 21.2.39. Appl. 3.5.38. Bottom-hole sampler.

R. Smith and R. A. Mueller. U.S.P. 2,148,327, 21.2.39. Appl. 14.12.37. Well-head fitting.

J. Lemley. U.S.P. 2,148,360, 21.2.39. Appl. 30.12.37. Oil-well casing head and tubing hanger.

J. W. Taylor. U.S.P. 2,148,592, 28.2.39. Appl. 31.12.36. Flow valve for starting wells flowing.

A. M. Whitney. U.S.P. 2,148,717, 28.2.39. Appl. 21.1.37. Process for recovering oil from an oil stratum comprising sinking two adjacent wells and then forcing superheated steam into the first well so as to vaporize the oil stratum, shielding the sides of the first well to produce heat radiation only towards the second well, and using the second well for recovery.

F. C. Goldsmith. U.S.P. 2,148,929, 28.2.39. Appl. 5.10.37. Well pump.

L. Y. Faust. U.S.P. 2,149,427, 7.3.39. Appl. 12.10.37. A device for receiving artificial seismic waves, transmitted through the earth having a surface layer of softer material overlying a harder material, which comprises a rod of sufficient length to

pass through the soft layer to the hard material and a wave detector mounted on the upper end of the rod.

E. A. Kleiwer. U.S.P. 2,149,810, 7.3.39. Appl. 19.8.35. Scraper for oil well tubing.

C. A. Wittermark. U.S.P. 2,149,824, 7.3.39. Appl. 23.7.34. Tubing scraper.

J. L. Oehler. U.S.P. 2,150,077, 7.3.39. Appl. 11.2.38. Flow-regulating means for oil wells. L. V. W. C.

Transport and Storage.

732. Tank Strapping. P. Kerr. *J. Inst. Petrol.*, 1939, **25**, 109–136.—A paper with discussion, which deals in a comprehensive manner with the setting up of a tank calibration table and gives the chief precautions necessary to obtain high accuracy. G. R. N.

733. Heating of Petroleum on a Tank Farm by means of Hot Water. E. P. Ospital. *Bol. Inform. Petroleras*, February 1939, **16** (174), 12–16.—Description of installation of hot-water coils in the tanks on a tank farm at Comodoro Rivadavia, where, especially in winter, the oil is so viscous that pumping becomes very difficult. The water is heated by small gas-fired boilers which are thermostatically controlled. H. I. L.

734. Losses from Aviation Gasoline during Storage. E. S. Stakhovich. *Neft. Khoz.*, January 1939, **20** (1), 26–30.—Evaporation losses have been measured on two grey-painted tanks with breather valves, located within the Russian Far Eastern Coastal Territory, containing an aviation gasoline distilling between 38 and 170° C. Within 2½ months (April–June) of cool weather, weight losses amounted to 0·5%, I.B.P. dropped 7, F.B.P. 4° C., and volume distilled at 120° C., 3%.

Further measurements were carried out on three other tanks, from April to September, and a total yearly loss of 1·83% in weight was estimated.

The merits of various methods of eliminating breathing losses, including Wiggins steel balloons, are discussed. L. R.

735. Force Pumps. B. L. Astiz. *Bol. Inform. Petroleras*, March 1939, **16** (175), 36–38.—Description and illustration of new type of pump for withdrawing oil from the tanks. These are slow-speed ram pumps with adjustable stroke, operated in the same way as the well pumps. Their average stroke is 1·25 m., diameter of ram about 150 mm., number of strokes per minute 10, and normal output from 8–9 cu. m. per hour. They are being installed to replace the old type of lift pump, which was not satisfactory. The work is being done concurrently with the renovation of worn-out tanks. H. I. L.

Gas.

736. Revised Method of Testing Gasoline Content of Gas. Anon. *Oil Gas J.*, 4.5.39, **37** (51), 52. (Paper presented before Nat. Gas Assoc. of America, Tulsa Meeting, May 1939.)—The method of determining the gasoline content of natural gas by compression, recently adopted by the Natural Gas Association of America, is now published, and is expected to receive the formal approval of the American Gas Association shortly. The new method is a revision of that portion of Code 101 jointly adopted by the N.G.A.A. and the A.G.A. in February 1933, and is expected to become effective as a tentative standard on 1st July, 1939. C. L. G.

737. Preventing and Removing Gas Hydrate Formations in Natural Gas Pipe Lines. E. G. Hammerschmidt. *Oil Gas J.*, 11.5.39, **37** (52), 66. (Paper presented before Nat. Gas Section of Amer. Gas Ass., May 1939.)—The introduction of anti-freeze

compounds into natural gas to prevent the formation of gas hydrates is discussed from the theoretical and practical aspects.

The formulæ for the lowering of the freezing-point of the hydrate by the addition of non-associating compounds (most organic materials and ammonia) and of associating materials (*e.g.*, $CaCl_2$) are presented. The effectiveness of 10% solutions of (*a*) ammonia, (*b*) methanol, (*c*) ethanol and calcium chloride, (*d*) *n*-propanol, (*e*) ammonium bicarbonate and (*f*) acetone, are shown in comparison with that of water in a graph giving the gas-hydrate decomposition temperatures.

Ammonia appears to be of outstanding value, except where CO_2 is present, owing to the formation of carbonates. It also has a definite corrosive action towards brass.

Methanol is an effective anti-freeze compound, being non-corrosive, inert, water soluble, widely available at a low price, and is 100% volatile under pipe-line conditions. Its vapour pressure is greater than that of water, thus preventing the deposition of additional moisture. Data on the freezing-point lowering of gas hydrates in methanol solutions are presented graphically, additional data being supplied to allow for the amount of water and hydrate in the line from a consideration of experimentally determined equilibrium conditions between the methanol vapour in the gas stream and that in the fluid at various temperatures and pressures. The advisability of introducing methanol as a vapour in order to utilize its latent heat of vaporization (512 B.t.u.), and thereby nullify the cooling caused by adding an alcohol to ice and water and in order to facilitate mixing, is emphasized.

Atomization by a spray nozzle may be used, since the cooling effect of the latent heat of vaporization is generally dissipated, owing to the much greater bulk of gas.

Test data under actual operating conditions are given, together with details of a method for the determination of methanol vapour in natural gas. C. L. G.

Cracking.

738. Patents on Cracking. L. A. Mekler. U.S.P. 2,152,905, 4.4.39. Appl. 13.6.35. Reforming process of conversion of relatively low-boiling hydrocarbon-oil distillates containing gasoline fractions of low anti-knock value, in order to enhance the anti-knock value.

E. A. Ocon. U.S.P. 2,154,820, 18.4.39. Appl. 11.3.37. Heat treatment of mineral oils to produce anti-knock motor fuel and lubricants. The oil is first cracked to form gasoline vapour, which is separated from the liquids higher-boiling than gasoline. The vapour products are subjected to catalytic alkylation and the products are fractionated to recover condensates and gaseous material composed chiefly of CO and H_2. These gaseous products are subjected to a synthesizing hydrogenation of CO to produce oxygenated hydrocarbon derivatives and hydrocarbons. The synthesized products are then fractionated to obtain a gaseous mixture containing unreacted CO and H_2, lower alcohols and hydrocarbons, and using the gaseous mixture in the alkylation. W. S. E. C.

Hydrogenation.

739. Cracking Hydrogenation of Petroleum Residues of Bucsani. C. Cândea and L. Sauciuc. *Petrol. Z.*, 1939, **35**, 361–364.—Hydrogenation tests on Roumanian oil residues showed that a sufficient saturation of the unsaturated cracking products is possible at 430° C. only if a catalyst and very high hydrogen pressures are used. At a working temperature of 440° the yields of petrol are better at the same pressures and with similar quantities of catalyst. It was not possible to use higher temperatures, because the resulting cracking pressure amounted to more than the allowable working pressure of the autoclave. Molybdenum trisulphide used as catalyst resulted in better cracking and higher yields of petrol, whereas molybdenum trioxide gave a more pronounced hydrogenation effect, lower petrol yields, and petrol of a more saturated character. E. W. S.

740. Heavy-Current Technique in Synthetic Fuel Installations. A. Zachmann. *Petrol. Z.*, 1938, **34** (30), 1–7.—A review of modern electrical practice and equipment, more

particularly in coal-hydrogenation plant, Fischer–Tropsch plant, etc. The following branches are covered :

(*a*) Power generation and distribution.
(*b*) Motors.
(*c*) Flame protection.
(*d*) Temperature control in reaction chambers.

An extensive bibliography is quoted. C. G. G.

741. Patent on Hydrogenation. E. A. Ocon. E.P. 502,798, 20.3.39. Appl. 20.9.37. —Production of motor fuel by subjecting liquid petroleum products to a non-destructive hydrogenation. The materials present in the vapour phase are separated from those remaining in the liquid phase, and the latter are then cracked above the critical temperature. W. S. E. C.

742. Patent on Dehydrogenation. I. G. Farbenindustrie A.-G. E.P. 502,675, 21.3.39. Appl. 21.9.37.—Manufacture of cyclic hydrocarbons by heating a diterpene to 200°–350° C. in the presence of a catalyst, *e.g.*, activated carbon which has been treated with phosphoric acid or phosphorous pentoxide. W. S. E. C.

See also Abstract No. 835.

Polymerization.

743. Catalytic Polymerization of Butanes from Natural Gas. F. B. Mack. *Oil Gas J.*, 4.5.39, **37** (51), 60. (Paper presented before Nat. Gas Assoc. of America, Tulsa Meeting, May 1939.)—A description, with flow sheets, operating data, and properties of products, is given of a butane catalytic polymerization plant at a McKee (Texas) Refinery. Butane is charged to a cracking furnace, the exit gases containing 11·36% propylene, 1·18% *iso*butylene, 0·82% butylene, and 46·00% butane. Some pyrolytic polymer is also separated. The above constituents of the exit gases are heated to 380–440° F., and thence passed to the catalyst polymerization towers. A conversion of 86% of the olefines present into polymer is obtained, the product being depropanized and the bottoms from this stage stabilized to 6–10 lb. Reid. The overhead product from the stabilizer (butane) is condensed and recycled. An overall conversion of 40% of butane to polymer is obtained by keeping the ratio of combined feed to fresh feed at 2·5 to 1, the yield of pyrolytic polymer from the butane cracking-furnace bottoms being about 8–10% of the total polymer yield. The blending value of the catalytic polymer when mixed with 66 O.N. pressure distillate and natural gas to 72 O.N. was found to be 95, and when mixed with 50 O.N. straight-run gasoline and natural gas to 72 O.N. fuel was found to be 102. In general, the polymer products show, in addition, low sulphur and gum, high inhibitor susceptibility in blends of low end-point, and distillation range of motor-fuel requirements. C. L. G.

744. Patents on Polymerization. G. W. Johnson and I. G. Farbenindustrie A.-G. E.P. 502,730, 20.3.39. Appl. 20.9.37. Manufacture of polymerization products by treating with boron fluoride or aluminium chloride, a mixture of styrene or styrene admixed with *iso*butylene, and a liquid hydrocarbon mixture containing unsaturated constituents obtained either by cracking or dehydrogenating hydrocarbons, or synthetically from CO and H_2.

Houdry Process Corp. E.P. 503,913, 12.4.39. Appl. 12.10.37. Catalytic polymerization of olefines in which the active contact material is a blend or compound of silica and alumina, and sufficient pressure is imposed to keep the charge in a liquid phase condition. W. S. E. C.

Synthetic Products.

745. Practical *v.* Theoretical Yield of Fischer–Pichler Mean-Pressure Synthesis. F. Fischer and H. Pichler. *BrennstChemie*, 1939, **20**, 221–228.—How far it is possible to approach theoretical yield figures in the mean-pressure synthesis has been investi-

gated by careful balancing test conditions (see Abstr. No. 280, 1939). By this means from 1 standard cu. ft. of gas approximately 5·4 gm. of solid, fluid, and gas ($C_3 + C_4$) hydrocarbons could be obtained, *i.e.*, about 90% of the theoretical figures.

A reduction in gas throughput combined with lower temperatures necessary increased the yield of higher hydrocarbons as shown graphically. With a throughput of 2 (0·2) litres gas mixture/gm. Co/hr. at optimum temperature, maximum total yields were between 4 and 4·3 (5·4) gm. per standard cu. ft., consisting of 14 (48)% paraffin wax, 73 (44)% liquid hydrocarbons, and 13 (8)% $C_3 + C_4$ hydrocarbons. Although a throughput of 0·2 litres/gm. Co/hr. would not be practicable, the possibility of a very close approach to the theoretical maximum yield has been proved in principle.

The mechanism of the reaction is discussed in detail. In the mean-pressure synthesis, activity and life of catalysts permit a complete conversion of the carbon monoxide–hydrogen mixture for long periods before reactivation becomes necessary. Further, formation of C_2 hydrocarbons being very limited, only the secondary reaction of methane formation has an essential effect on actual yields. It is shown, however, that methane formation can be suppressed to a very great extent, permitting an almost complete conversion of the carbon monoxide–hydrogen mixture into higher hydrocarbons. L. R.

746. Patents on Synthesis. G. W. Johnson and I. G. Farbenindustrie A.-G. E.P. 502,542, 20.3.39. Appl. 20.9.37. Conversion of CO and H_2 into hydrocarbons containing more than one carbon atom per molecule and/or liquid or solid oxygen derivatives of hydrocarbons using as catalyst a sintered metal of the iron group which is surrounded by a liquid.

Ruhrchemie A.-G. E.P. 502,771, 24.3.39. Appl. 5.4.38. Catalytic conversion of CO and H_2 into liquid or solid hydrocarbons.

I. G. Farbenindustrie A.-G. E.P. 503,247, 4.4.39. Appl. 29.10.37. Catalytic conversion of CO and H_2 into hydrocarbons or their oxygen-containing derivatives. W. S. E. C.

Refining and Refinery Plant.

747. Performance of Ejectors as a Function of Molecular Weights of Vapours. L. T. Work and V. W. Haedrich. *Industr. Engng Chem.*, 1939, **31** (4), 464.—Two ejectors were studied using vapours having a molecular weight variation of 18–154. By applying the Carnot efficiency of compression compared with that of suction, the performance of an ejector can be represented by a single line, regardless of vapour molecular weight or exhaust pressure. Entrainment was studied using one- or two-component systems, and the results are correlated so that the behaviour with any combination of vapours may be predicted from a knowledge of the performance of an ejector on steam. The applications of the results to stills and to air-conditioning systems are discussed. P. D.

748. Liquid Hold-up and Flooding in Packed Towers. J. C. Elgin and F. B. Weiss. *Industr. Engng Chem.*, 1939, **31** (4), 435.—Experiments covering a wide range of flow of water and air were made in a 3-in. glass column packed with 0·25-in. and 0·5-in. Berl saddles, 0·625-in. clay Raschig rings, and 0·5-in. clay balls. Visual observation of flooding was made, and rates and pressure drop were measured. In general, hold up is not increased by gas velocity until the critical point is reached; and with or without gas flow it varies linearly with liquid velocity except at low liquid flows. The results at the flooding point may be correlated by three methods: by plotting square root of the gas velocity against the liquid velocity on rectangular co-ordinates, in which case a series of straight lines is obtained; by the method of Sherwood, Shipley, and Holloway (*Industr. Engng Chem.*, 1938, **30**, 765); or by an empirical method suggested by the authors. The mechanism of flooding is discussed in a general manner. P. D.

749. Fluid Resistance in Pipes. M. P. O'Brien, R. G. Folsom and F. Jonassen. *Industr. Engng Chem.*, 1939, **31** (4), 477.—The data of Nikuradse and of White on the

behaviour of artificially roughened pipes are compared with data on commercial pipes, in order to obtain the equivalent roughness of the latter. Clean commercial pipes do not follow a curve similar to that of Nikuradse in the transition region between smooth and fully developed turbulent conditions, and the theory of turbulence does not provide a generalized treatment applicable to this important region. P. D.

750. Effect of a Screen Grid on Turbulence of an Air-Stream. W. L. Towle, T. K. Sherwood and L. A. Seder. *Industr. Engng Chem.*, 1939, **31** (4), 462.—The method described in a previous paper (*ibid.*, p. 457) was used to measure the eddy diffusivity at points 0·5–62·5 duct diameters downstream from a wire grid in a 12-in. duct. Over the first 15 diameters downstream the presence of the grid decreased the eddy diffusivity by over 50%, but it approached the no-grid value asymptotically at a point 45 diameters downstream. The Reynolds number varied from 86,000 to 91,000 in these tests. P. D.

751. Eddy Diffusion : Mass Transfer in the Central Portion of a Turbulent Air Stream. W. L. Towle and T. K. Sherwood. *Industr. Engng Chem.*, 1939, **31** (4), 457.—Air flows were studied in two ducts 6 in. and 12 in. in diameter at Reynolds numbers from 12,000 to 180,000. CO_2 or H_2 was admitted centrally into the stream through a tube of stream-lined shape, and samples were removed from the central third of the diameter at a point 69–70 diameters downstream from the point of admission, and analysed. The results were analysed by applying a modification of the Wilson formula for heat conduction, and values of the eddy-conductivity obtained. These were of the order of 100 times the value for molecular diffusivity, and are plotted against Reynolds number, with which they correlate well. Kinematic viscosity of the fluid was not, however, varied. P. D.

752. Correlation of Rotameter Flow Rates. J. C. Whitwell and D. S. Plumb. *Industr. Engng Chem.*, 1939, **31** (4), 451.—A method of correlating flow rates for various liquids and floats is proposed, based on the application of Bernoulli's equation. The method is applied to results of experiments on a single tube using floats of lead, steel, aluminium, and rubber, using as fluids acetone, water, carbon tetrachloride, and sugar solutions. The correlation can be applied only above certain critical Reynolds numbers, and the liquids are classed as thick or thin. The intermediate range between these two classes is not determined. The application of the method is illustrated by examples. P. D.

753. Reduction of Shock Pressures in Solvent Delivery Lines. H. S. Gardner and J. H. Folwell. *Industr. Engng Chem.*, 1939, **31** (4), 446.—The simple theory of the production of shock pressure upon sudden closure of a valve is presented. The effects of shock pressure in a solvent delivery line and the steps taken to eliminate it are described. P. D.

754. Turbulence and Diffusion. H. L. Dryden. *Industr. Engng Chem.*, 1939, **31** (4), 416.—Modern theories of turbulence as developed by G. I. Taylor and von Karman are reviewed in connection with the diffusion induced in the fluid. Diffusion may be due to molecular motion or to isotropic or non-isotropic turbulence. All three cases may be dealt with mathematically, and the theory is illustrated by discussion of experiments on the diffusion of heat from a hot wire and on the mixing produced by jets. In particular the separate effects of scale and intensity of turbulence, and the differences between the diffusion of momentum and heat or matter, are emphasized. P. D.

755. Pressure Drop Accompanying Two-component Flow through Pipes. L. M. K. Boelter and R. H. Kepner. *Industr. Engng Chem.*, 1939, **31** (4), 426.—Experiments were made on the flow of unemulsified mixtures of air and oil, or air and water through

½-in. and ¾-in. pipes. The pipes were placed horizontally or at a gradient of 1 : 6. Pressure drops and the fraction of pipe volume occupied by liquid are reported. P. D.

756. Selection of Pumps for Chemical Service. W. E. Pratt. *Industr. Engng Chem.*, 1939, **31** (4), 408.—A general discussion of the various types of pumps used in chemical plant is presented. P. D.

757. Heat Transfer in Natural Convection Evaporators. G. A. Akin and W. H. McAdams. *Industr. Engng Chem.*, 1939, **31** (4), 487.—Film coefficients were determined for short, straight, nickel-plated copper tubes 0·75 and 0·54 in. o.d., using water and three alcohols at atmospheric pressure and under vacuum. The heat flux was plotted against temperature difference, and a maximum value was obtained in all cases. The results are compared with those of previous observers. The effect of wetting agents was also observed in a few experiments. Further experiments were made using a tube bundle, and the results obtained checked with those on the single tube. P. D.

758. Effects of Gas Injection on Natural Gasoline Plant Operation. H. N. Wade. *Refiner*, 1939, **18**, 31.—The above subject is discussed in general terms under: the effect on the quality of the wet gas, the effect on the quantity of wet gas, the effect on the life of gasoline plant operation, the selection of trapping and gasoline plant pressures, compressor horse-power requirements, high-pressure compressor installation and operating costs, piping standards and safety provision, hydrate formation at high pressures, and the effect on plant design. It is concluded that gas-pressure maintenance or repressuring operations tend to improve the operating conditions of natural gasoline plants associated with them: (*a*) by greatly increasing the average operating life, (*b*) by stabilizing the rate of natural gasoline production and (*c*) by preventing waste of dry gas, which may be eventually sold. G. R. N.

759. Purification of Absorption Oil. W. A. Stover. *Refiner*, 1939, **18**, 89.—A new unit for the purification of absorption oil is described. It consists of a still and a heater which discharges its product directly back into the main absorption oil still. About 1% of the rich oil stream to the rich oil preheater is diverted and passed through the purifying unit, into which the agitation steam is charged instead of to the main still. This steam, together with the lighter fractions vaporized from the oil, then pass to the main, where the usual stripping operation is carried out. The quantity of steam consumed by the purification unit heater is balanced by the reduction in steam requirements of the main still. Accumulated sediment and gum are removed at the bottom of the tank. Operation of this system reduced the temperature difference of the lean oil coolers and incoming cooling water from 9° to 2° F. after 45 days, and simultaneously reduced the percentage boiling above 525° F. from 27% to 2%. The gasoline content of the plant exit gas was reduced from 0·0549 to 0·0404 gals./1000 cu. ft. after 27 days. G. R. N.

760. Good Efficiency at Low Load at Wilmington. Anon. *Refiner*, 1939, **18**, 87.—A fields gasoline plant at Wilmington, California, having a wet gas throughput of 20,000,000 cu. ft./day and a gasoline distillation capacity of 30,000 gals./day, now operates on a reduced gas volume of 4,500,000 cu. ft./day. While this change in throughput permitted the more efficient extraction of the lower-boiling hydrocarbons, the finishing of the gasoline for the market resulted in over-fractionation of the raw gasoline. To conform to market requirements, and at the same time produce more finished gasoline, the vapour pressure was raised (to 23·7 lb.) by adjustment of the operating conditions on the stabilizer section. Complete operating data for a 24-hr. period is given. Two features of this plant are the entire condensation of exhaust steam and the cooling of engine jackets by water freed from scale-forming solids and circulating in a closed system. G. R. N.

761. Influence of Varying Chromium and Silicon Content on High-Temperature Characteristics of Steels. H. E. White, C. L. Clark and W. G. Hildorf. *Refiner*, 1939, **18**, 58.—The high-temperature properties of eleven steels varying in chromium content

from 0·0 to 6·0% and in silicon content from 0·20 to 1·5% were examined. Each steel contained 0·5% molybdenum. These properties included tensile-strength yield stress, ductility, Charpy impact resistance, Brinell hardness, and grain size. Certain of the more definite effects observed are summarized as follows: (1) Increased silicon content, especially in the presence of chromium increase, (*a*) the room-temperature strength and hardness, (*b*) the short time strength at 750° and 900° F., (*c*) the hot impact resistance, (*d*) the oxidation and corrosion resistance, (*e*) the rupture strength at the more elevated temperatures, and (*f*) the life of the steel in service, especially because of increased surface and structural stability. (2) On the other hand, increased silicon content lowers (*a*) the room-temperature ductility and impact resistance slightly, and (*b*) the creep strength at the intermediate temperatures. (3) Increased chromium content increases (*a*) the room-temperature ductility and impact resistance, (*b*) the corrosion resistance, (*c*) the oxidation resistance at the intermediate temperatures, and (*d*) the short-time high-temperature strength and creep resistance in amounts up to 1 to 1·5% chromium. (4) The results are believed to show definitely that very satisfactory steels for high-temperature service can be obtained through a proper combination of chromium and silicon in the presence of 0·5% molybdenum.

G. R. N.

762. Direct Solution of Isothermal Flow in Long Pipes. C. F. Bonilla. *Industr. Engng Chem.*, 1939, **31** (5), 618.—The customary method of solving for pressure drop in a pipe is based on the use of the two dimensionless groups, the Reynolds number and the friction factor. When these are used, the pressure gradient can be calculated directly, but calculation of any other variable involves a process of trial and error. The variables may be collected in other dimensionless groups, notably the von Karman number (which does not contain mass velocity), and a group which it is proposed to call the Size Factor (which does not contain diameter). By means of suitable plots containing the four dimensionless groups, it is possible to solve directly for any variable except viscosity, which is not usually required. P. D.

763. Problems in Heat Exchange and Pressure Drop. L. Friend and W. E. Lobo. *Industr. Engng Chem.*, 1939, **31** (5), 597.—The tube area required in a gas-oil cooler is worked out by three methods, one due to Sieder and Tate (*Industr. Engng Chem.*, 1936, **28**, 1429), and two to Colburn (*ibid.*, 1933, **25**, 873). The pressure drop is also calculated by methods due to the same authors. The complete working and necessary charts are given.

As a second problem the pressure drop due to gas-oil vapour flowing through a packed tube is worked out by the method of Chilton and Colburn (*ibid.*, **23**, 913).

P. D.

764. Flow of Suspensions through Pipes. R. H. Wilhelm, D. M. Wroughton and W. F. Loeffel. *Industr. Engng Chem.*, 1939, **31** (5), 622.—Pressure drops were measured for the flow of suspensions of cement rock and Filter-Cel through 27-ft. lengths of 0·75-, 1·5-, and 3-in. pipe. The apparent viscosities of the suspensions were also measured in a rotating viscometer. The cement rock suspensions were 54% and 62% by weight, and the Filter-Cel from 21% to 34%.

The cement rock gave suspensions which resulted in "plug" (non-Newtonian) flow at low rates of shear, merging into turbulent flow at high rates. The Filter-Cel suspensions gave viscous and turbulent flow.

The observations in the turbulent region can be correlated by means of the usual Reynolds number plot if the viscosity used in calculating the Reynolds number is that obtained from viscometer measurements extrapolated to zero shear. P. D.

765. Catalytic Polymerization and Copper Sweetening. J. C. Albright. *Refiner*, 1939, **18**, 91.—Sunray Oil Co, Allen, Oklahoma, who operate a 3600-brl. Dubbs unit, installed late in 1938 a catalytic polymerization unit to charge the pressure distillate overhead amounting to 550,000 cu. ft. per day. This gas contains 35% olefins, and is mixed with an equal volume of residue gas from the "poly" unit which reduces the unsaturate content to around 20%. Stabilized polymer gasoline is produced

at the yield of 3500 gals. per day and has a 95 octane blending value for 426° F. end. point. The charge is heated to 385° F. at 485 lb. pressure, and leaves the two catalyst towers (in series) at 450° F. and 460° F., respectively. The polymer gasoline is stabilized in a ring-packed tower to 24 lb. Reid. Operation of the unit to the time of writing had covered a period of 32 days and indicated around 95% conversion of the olefins. The polymer gasoline is sweetened in a U.O.P. copper-treating unit after an initial caustic wash and sand percolation to remove moisture. This unit is the conventional two-tower system with air-release equipment between the towers. After sweetening, the gasoline is inhibited. Construction details are given.

G. R. N.

766. Dehydration of Natural Gas. H. M. Baker and J. W. Partridge. *Oil Gas J.*, 13.4.39, **37** (48), 50. (Paper presented before A.P.I. Eastern District (Production Division) Meeting, Pittsburgh, April, 1939.)—A summary is presented of the experiences gained in the design, construction, and operation of three natural-gas dehydration plants in operation in the Charleston group of the Columbia system.

The first plant described is a combination water-dehydration and partial-condensation hydrocarbon-removal plant using a refrigerated $CaCl_2$ water solution. The gas is passed through a cold gas heat exchanger to a separator, where entrained liquid condensates are removed, and thence to a contactor and chilling column, where it is chilled and scrubbed with calcium chloride solution refrigerated by ammonia. Hydrocarbons are removed from the calcium chloride solution by passing to the pressure separating-chamber. A brine concentrator removes the moisture collected from the gas.

The second plant at the outlet of a natural gasoline station utilizes a calcium chloride glycerine solution to remove water vapour only. The gas is delivered to the lower sections of parallel multi-stage contactors, where entrained liquids are removed and drained off, and then passes upward through baffles and a series of contactor trays, where it is brought into contact with a solution (cooled by heat exchange and by water) containing 40% $CaCl_2$, 20% glycerine, and 40% water. The treated gas passes through final entrainment separators to the main line. The solution passes through a steam preheater into a fractionating column, where excess water is stripped by contact with a small quantity of low-pressure high-temperature gas.

The third plant handles gas passing through 450 miles of 20-in. line, and uses a diethylene glycol absorbent. The gas flow is similar to that of the second plant, but the solution of diethylene glycol is revivified by live steam. The absorbent apparently absorbs condensable hydrocarbons from the gas as well as water vapour.

It is felt that the refrigerated $CaCl_2$ solution plant is highly satisfactory for removing only hydrocarbons which would otherwise be condensed, any desired dew-point depression being obtainable. The calcium chloride plant is satisfactory where the dew-point depression need not exceed 30–35° F., and the diethylene glycol for depressions of from 40° to 45° F.

C. L. G.

767. Hydrogen Sulphide removed by using Tripotassium Phosphate. J. M. Mullen. *Oil Gas J.*, 13.4.39, **37** (48), 37.—A plant operating on the tripotassium phosphate process for the removal of H_2S has been installed at a Watson (Calif.) refinery to treat 35,000,000 cu. ft. per day of overhead (C_1 to C_4) gas from the gasoline stabilizer unit prior to its passage to a catalytic polymer plant. The H_2S content is reduced from 3000 grains to 100 grains per cu. ft. Absorption is accomplished by the following reaction: $K_3PO_4 + H_2S \rightarrow K_2HPO_4 + KHS$, the reaction being reversed during regeneration. Ammonia, but not mercaptans, is absorbed by the solution, which contains 2·0 gm.-mols. K_3PO_4 per gm. The gas at 175 lb. pressure and 150° F. is admitted at the bottom of a 48-in.-diameter absorber tower containing thirty-six bubble plates, spaced 18 cm. apart, the solution entering at plate 18. The foul solution is released by level control to the regenerator—a steam-heated boiler—from whence the solution passes to a surge tank, where it is kept at boiling point to complete regeneration, and is finally cooled and returned to the absorber. The vapours from the regenerator pass to a condensate stripper, the condensate being returned to the top of the absorber and the H_2S overhead passed to a waste-products burner. The equilibrium solution saturation is greater for a dilute solution than for a more con-

centrated one, so that the bulk of the stripping is performed with a concentrated solution in the lower section of the absorber, and a dilute solution (from condensate stripper plus a portion of regenerated solution) used to remove the last traces of H_2S in the upper section. Solution loss is negligible, whilst the absorbent salt is stable and non-volatile and enters into no side reactions and introduces no impurity. No noticeable corrosion of the plant has taken place since being placed on stream in October. C. L. G.

768. Desulphurization of Sulphur-Gasolines by Means of Aluminium Chloride. A. Ya. Semyonova and D. L. Goldstein. *Neft. Khoz.*, February 1939, **20** (2), 31–35.—The tests revealed that $AlCl_3$ is highly effective in desulphurizing high-sulphur gasolines prepared from Ishimbaevo, Syzran, Tuimas, and Krasnokamsk crudes. In the process of reaction, at relatively low temperatures (30–40° C.), complex liquid compounds were formed. These liquid compounds were easily pumped through pipes, so that semi-continuous operation was possible.

Optimum results were obtained with gasolines which had undergone a preliminary alkali wash prior to the application of $AlCl_3$, but they were considerably affected when the gasoline had been stored for a long period. Alkali-treated Ishimbaevo gasoline with a F.B.P. of 143° C. could be desulphurized with $AlCl_3$ between 20° and 30° C. S contents were reduced under laboratory conditions from 0·48 to 0·039%. Results were improved by increasing agitation.

Time of reaction depended on temperature, percentage of $AlCl_3$, intensity of agitation, etc. In the above experiments, optimum reaction time was 1 hr.

Tests on a semi-technical laboratory set-up at atmospheric pressure with circulation and injector agitation of the liquid phase gave similar results to laboratory tests with mechanical agitation.

By re-using the liquid compound, the consumption of $AlCl_3$ could be reduced to 0·35–0·4%.

In the process of desulphurization of gasoline by $AlCl_3$ the lead susceptibility was improved, *i.e.*, the octane number of Ishimbaevo gasoline (F.B.P. 143° C.) was increased by addition of 3 ml. $PbEt_4$/kg. from 55 to 83; that of Syzran gasoline (F.B.P. 140° C.) was improved by addition of 3 ml. $PbEt_4$/kg. from 48 to 79. L. R.

769. Effect of Hydrogen Peroxide in Spent Doctor Regeneration. V. W. Wilson. *Refiner*, 1939, **18** (3), 96.—Frequently doctor solution is regenerated after use by air blowing at temperatures in the range 120–200° F. in a suitable tower system. It has been found that the addition of a small proportion of concentrated hydrogen peroxide together with the air at the outset of the reclamation operation improves the quality of the regenerated doctor solution. It is believed that the effect of the hydrogen peroxide is two-fold: first it releases nascent oxygen, which reacts with the lead sulphide, and second, it promotes the activation of the doctor solution. It has been noted that this reagent attacks lead mercaptides, giving lead oxide and organic disulphides. Data are given on full-size plant tests, and show that the time of regeneration is decreased, the litharge content of the reclaimed doctor solution is increased, and the thiosulphate content is decreased. In general, it is concluded that the process is economically attractive to refiners using any quantity of fresh litharge for replacement purposes. G. R. N.

770. Patent on Refining. G. W. Johnson and I. G. Farbenindustrie A.-G. E.P. 502,193, 14.3.39. Appl. 15.10.37. Purification of waste aqueous liquors containing phenol. W. S. E. C.

Safety Precautions.

771. Respirators. R. W. Gorman Davis. *Chem. and Ind.*, 1939, **58**, 334–336.—The following types of respirator, with their uses and limitations, are described, and suggestions are given to assist in selecting equipment for various chemical processes. As regards dust respirators, the Mark IV instrument evolved by D.S.I.R. is comfortable, efficient, and has low breathing resistance. Anti-gas respirators have a life at a given air rate roughly proportional to the concentration of gas. In the case of acid gases,

indicators are already available showing when the limit of life is reached. In other cases, indicators are being developed. Of interest to the petroleum industry is the fact that the box type of anti-gas respirator is not to be used in stills, tanks, etc., where gas concentration may be high, or where there is a shortage of oxygen. Alternatives are: "hose-masks," through which the wearer inhales by his own lung power, and also the "compressed-air-line respirator." The air fed by a compressor preferably via a safety tank should be free from oil vapour. The "self-contained oxygen-breathing apparatus" renders the wearer independent of the atmosphere, and permits unhampered work in high concentrations of gas and in difficult places. A cylinder of oxygen supplies gas to a flexible bag, into and out of which the wearer breathes.

J. L. T.

772. Some Points in the Design and Inspection of Pressure Plant. A. H. Goodger. *Chem. and Ind.*, 1939, **58**, 352–358.—Design of pressure plant has of recent years been simplified as a result of the study of the mechanism of fatigue. An example given is that of a solid forged drum of smooth surface and uniform section. Stress required to produce fatigue failure is reduced when the surface is wetted with a liquid, even such a mildly corrosive liquid as distilled water. Vibration and bending stresses at high temperatures while under the action of liquids are important factors. As regards materials for high temperatures and pressures, mild steels are usually satisfactory up to 900° F. Above this temperature it is usual to employ low alloy steels—*e.g.*, molybdenum steels. Creep or continuous permanent deformation is a factor to be considered. Accelerated tests to determine this come in for some criticism on the score of the excessively high stresses involved, stresses which are necessarily higher than in practice. High-temperature action on steels under stress lowers the impact value, a test which it is considered requires some clarification. This test is also used to determine the effect of low temperature, which also causes embrittlement of most metals. In the latest designs of vessels for liquid gases, arrangements are made to prevent the actual pressure vessel from reaching very low temperatures. For resisting the scaling action of hot gases, water vapour and other corroding agents, *e.g.*, in cracking, the higher alloy steels of the stainless chrome-nickel class have been found advantageous. Other factors considered in the article are corrosion, welding as an adjunct to design and construction, jacketed pans, flanges, welded stays, seal welding, welding of stainless steels and clad metals, heat treatment of welded vessels, and inspection. (9 references.)

J. L. T.

773. Function of the Works Management in Safety. R. J. Woods. *Chem. and Ind.*, 1939, **58**, 347–351.—The initiative for accident prevention lies with the management, says this author. Until just apportionment is possible, the management should assume complete responsibility. As regards the human element, it is suggested that too much is expected from the workman, with his limited education and intellect, whilst the staff man cannot or will not see with the workman's eyes nor think with his mind. The psychological factors involved should be appreciated. Examples are fear of heights and enclosed places, and a desire to attract attention by "daring do." Accidents are classified broadly as those resulting from movement, *i.e.*, of personnel and of objects, and those resulting from chemical action. The former are more frequent. An accident should be defined by its cause rather than by its effect. Most classifications of accidents are misleading, and are mainly lists of items incidental to the causes. A list of possible causes includes worry, fear, superstition, fatigue, ill-health, etc. There is need of further research to ascertain the real causes. In investigations no attempt should be made, it is considered, to apportion blame, but rather to devise means to prevent repetition. Safety measures are fundamental considerations, and should be included in design, and not added afterwards. Instructions should be simple and clear, and personal protection considered a temporary measure until plant and process can be improved to eliminate risks. As regards frequency and severity of accidents, it is indicated that some clarification of the mode and meaning of expression is necessary.

For instance, as regards severity, this should be subdivided to separate time lost, rate of fatality, and number and type of permanent disability. As regards propaganda, it is suggested that posters should be designed on simple lines, avoiding caricature

of the workman. Illustrations are preferably photographs of local interest. Information and statistics should be published sparingly and in simple form, and lectures should not stress the workman's responsibility, but show sympathy in the worker's task. Safety competitions are considered of doubtful value, as they tend to induce concealment and perhaps to reduce the period of necessary absence. The article ends with a summary of conclusions and recommendations. J. L. T.

774. Protective Clothing and Appliances. R. E. Tugman. *Chem. and Ind.*, 1939, **58**, 342–347.—A description is given of efforts made to supply the most suitable protective clothing for a particular set of conditions. A hard hat protects the wearer's head from falling objects. Peaks may be at front and back if necessary. As regards protection of face and eyes, goggles should be worn if there is still risk after providing a shield. Such goggles should give the maximum protection consistent with comfort. They should be light, give clear and wide vision, and be without tendency to dim. Specifically the following types are amongst those which have been found suitable. For protection from dust, the Industrial Eye Veil and the folding celluloid goggle are two types, whilst from relatively large flying objects, the wire-basket goggle, with or without side-screens, is described. For protection against splashes of corrosive liquids and molten metal, the spectacle goggle, but, better, the closed splash-proof chemical goggle, is recommended. The latter has a tendency to dim, and in some cases a visor giving 90% protection is preferred. Protection against irritant gases demands an unventilated goggle. The dimming tendency of this type is to some extent overcome by inserting gelatine-coated celluloid eyepieces in gas masks. Protection from harmful heat rays, *e.g.*, for welders and furnace workers, is not provided by blue or blue and red glass, as is commonly supposed. Green is a better colour, and it is suggested that the recent B.S.I. standard be adhered to. As regards body protection, briefly two types cover most risks. One is a suit, and the other an apron of Neoprene. For the arms and hands, gauntlets or, preferably, rubber gloves and armlets give protection against corrosives, which are the main risk. Where the corrosive is solid, thick twill gloves are preferable to rubber. For protection of the legs and feet, rubber boots or Wellingtons are adequate. Where perspiration is a problem, the clog is an alternative, or against caustic soda in particular a leather-lined canvas-topped boot with an internal steel toe-cap is used. Soles should be of a type to guard the wearer against slipping. Photographs illustrate some of the types described. Provision of protection should be supplemented by education in its use. J. L. T.

775. Factories Act 1937. H. Ewart Hopthrow. *Chem. and Ind.*, 1939, **58**, 336–338.—This article is an attempt to collate some of the provisions of the Act and Regulations under some headings, as guidance in the design of factories and equipment, with particular reference to chemical works. Buildings should be of minimum size, properly heated, cooled, and ventilated, readily cleaned to a proper standard, and made safe in respect of equipment such as lifting gear, etc. In the case of chemical works, protective clothing must be properly stored and, if necessary, laundered. As regards lifting gear, openings and lifts must be properly enclosed, and cranes must be firmly anchored, and on a level runway. New equipment of this kind should have test certificates. For lighting, the Home Office is issuing a memorandum suggesting proper standards of artificial lighting. Windows must be cleaned inside and outside. Water for drinking and also for washing, and in certain chemical works for baths, must be provided. Where poisonous substances, *e.g.*, lead compounds and arsenic, are likely to be encountered, special provision must be provided for washing, accommodation for clothing, and mess-rooms. Fire hazards are dealt with in relation to the necessity for providing escapes and alarms, to be approved by the local authority. First-aid boxes, cupboards, and possibly ambulances, must be provided. As regards prime movers, flywheels and generators must be fenced off, and exhaust gases of I.C. engines must discharge into the open air, and the engines must be partitioned off. Similarly, belts and gears must be fenced off and means provided for cutting off power. This requirement is relaxed in certain circumstances, *e.g.*, when the machinery is in a suitably safe place or must receive attention while in motion. Dangerous fumes

in confined spaces must be exhausted, breathing apparatus provided for persons working in such spaces, and minimum manhole-cover size is specified. Of particular interest to the petroleum industry are descriptions of procedure of opening plant containing explosive or inflammable vapour and for heating, *e.g.*, welding equipment which contains or has contained such vapour. Boiler furnaces or boiler flues should not be worked upon until they are cool. J. L. T.

Chemistry and Physics of Petroleum.

776. Drainage of Viscometers and Pipettes. G. Jones and E. Ferrell. *J. chem. Soc.*, February 1939, 325–332.—The authors describe the apparatus and methods employed for the measurement of absolute drainage error of variously shaped viscometer bulbs operated so that the efflux time of the liquid under investigation can be varied. Liquids used included water, methanol, butanol, and 1·46 *N*-potassium chloride solution. The latter liquid has the same absolute viscosity as water, but a different density and surface tension.

The results show that the total volume of after-drainage multiplied by the outflow time is a constant for any given pipette and any liquid. Further, this constant is proportional to the kinematic viscosity of the liquid used, thus the data show that the relationship $\frac{t.d.\Delta V}{\eta}$ is constant for the four liquids when examined in the same pipette.

The work has included an examination of three pipette shapes—namely, cylindrical, spherical, and conical—the latter consisting of a bulb formed approximately similar to the shape of the two cones base to base. The latter form of bulb is to be preferred, since for a given liquid with a given efflux time the total volume of after-drainage is the least, with the bulb of cylindrical shape the next best. W. E. J. B.

777. Preparation of Carbon Disulphide from Methane and Hydrogen Sulphide. H. I. Waterman and C. Van Vlodrop. *J. Soc. chem. Ind.*, 1939, **58**, 109–110.—This paper presents results obtained from experiments on the synthesis of carbon disulphide, using pure and technical methane. Most of the experiments were carried out at atmospheric pressure at temperatures between 1080° and 1280° C., and using gas mixtures consisting of 1 vol. of methane to 2 vols. of hydrogen sulphide. A quartz reaction vessel was used.

In general, the yield of carbon disulphide increased with temperature over the range noted above, and the best conversion results were found with about 70% of hydrogen sulphide in the reaction mixture. This mixture gave the smallest formation of carbon, sulphur, and tarry products, as well as a maximum yield of carbon disulphide of 75%. The product obtained was comparatively pure.

With inlet gas containing 2 vols. of hydrogen sulphide to 1 vol. of methane, the main reaction occurring is apparently

$$CH_4 + 2H_2S \longrightarrow CS_2 + 4H_2.$$

W. E. J. B.

778. Changes in Mineral Oil due to X-ray or Ultra-violet Irradiations. W. Stenstrom and I. Vigness. *J. Phys. Chem.*, 1939, **43** (4), 531.—Absorption curves were measured in the ultra-violet for a liquid paraffin after irradiating with X-rays for times up to 6000 min. The same oil was also irradiated for periods up to 300 min. with ultra-violet light, both after degassing and in the presence of absorbed CO_2, H_2, N_2, and O_2. The resulting chemical reactions were studied by comparing the absorption curves with those for solutions of known compounds in the paraffin oil, and from observations on the spreading of the irradiated oil on water. The general conclusions are that irradiation in an evacuated container causes a small amount of unsaturation in the paraffin chains, followed by polymerization. In the presence of oxygen unsaturated fatty acids are formed. The presence of other gases has no effect. P. D.

779. Considerations of a Vapour Pressure-temperature Equation and their Relation to Burnop's Boiling Point Function. W. H. Banks. *J. chem. Soc.*, February 1939, 292–295.—The author has examined the constants A and B in Young's empirical vapour-pressure equation $\log p = A - \frac{B}{T}$. The thermodynamic basis of this relation is considered, and it is shown that A can be expressed as $\log 760 + \Delta H_0/2{\cdot}303 RT_B$ with an accuracy of about 10% over a reasonable temperature range; ΔH_0 is the calculated heat of vaporization at the absolute zero and T_B the boiling point at atmospheric pressure. It is possible to calculate ΔH_0 from known values of B, and these are shown to be related to the formula weight by an approximate empirical equation from which may be derived Burnop's empirical function (*J. chem. Soc.*, 1938, 826).

Burnop's function is shown to be proportional to the formula weight from which follows its additive nature. W. E. J. B.

780. Concentric-cylinder Motor-driven Viscometer. R. H. Wilhelm and D. M. Wroughton. *Industr. Engng Chem.*, 1939, **31** (4), 482.—A concentric-cylinder viscometer with dynamometer mounting for the motor is described. It was calibrated in both stream-line and turbulent regions. In order to obtain reproducible results in the intermediate region between stream-line and turbulent flow, it is necessary to arrange baffles on the wall of the stationary cylinder. Their influence on the calibration is discussed. P. D.

781. Fatty Acids from Paraffin Wax (German Process). Anon. *Chem. Tr. J.*, 28.4.39, **104**, 402.—In an article by Prof. Dr. W. Schrauth in *Chem. Zeit.*, 19.4.39, further details are given of the process for the production of fatty acids by the air oxidation, in the presence of a catalyst, of the soft paraffin by-product of the Fischer–Tropsch process (see *J. Inst. Petrol. Tech.*, 1938, Abs. No. 1327). This product is preferred to the German lignite wax, as it is cheaper and yields purer fatty acids with a straight-chain or almost straight-chain structure, whilst the structure of the natural material is branched. Oxidation temperature is particularly important, a rise of a few degrees above 100° C. leading to considerable increase in peroxide formation. 100 kg. of wax are oxidized with 70 cu. metres of air for about 24 hr., yielding a product with 30–40% of crude fatty acids of saponification value 130–150. The reaction consists in the oxidative splitting of the hydrocarbon chain at any one of the CH_2 groups, and thus yields a mixture of fatty acids, some being lower members unsuitable for soap production, although the CH_3 group in the middle is generally attacked. The fatty acids contain members of odd or even numbers of carbon atoms, whilst those from natural fats invariably contain even numbers. Paraffin wax of I.B.Pt. about 320–330° C. gives far larger quantities of lower-boiling fatty acids than does a paraffin of I.B.Pt. 350° C.

The crude fatty acids are saponified to remove unsaponifiable constituents and the soaps split with a mineral acid. After washing with water the resulting product is distilled under a high vacuum and yields 50–80% of suitable distillate for soap production. The percentage composition of a representative distillate of fatty acids is given as: Caprylic 0·2%, pelargonic 1·6%, capric 4·1%, undecanic 8·0%, lauric 11·2%, tridecanic 13·5%, myristic 14·3%, pentadecanic 14·8%, palmitic 10·9%, heptadecanic 7·8%, octadecanic 6·8%, and higher acids 6·8%. C. L. G.

782. Melting Point and Molecular Weight in the *N*-Paraffin Series. A. H. Etessam and M. F. Sawyer. *J. Inst. Petrol.*, 1939, **25**, 254–262.—Two formulæ are derived from published data which relate mol. weight and melting point of the normal paraffin hydrocarbons. G. R. N.

783. Transition Effects in Paraffin Wax. C. R. Scott-Harley. *J. Inst. Petrol.*, 1939, **25**, 238–251.—The phenomenon of transition is discussed with respect to the higher paraffins and an attempt is made to show that it may exist in petroleum waxes. G. R. N.

784. Thermometric Determination of Transition Points in Paraffin Wax. H. D. Lord. *J. Inst. Petrol.*, 1939, **25**, 263–276.—The cooling curves of several waxes and their fractions were determined, and by using the inverse rate of plotting the results the phenomenon of transition is depicted in graphical form. G. R. N.

785. Analysis of Oil-wax Mixtures. H. D. Lord. *J. Inst. Petrol.*, 1939, **25**, 277–287.—Experimental work is described which shows that the oil content of an oil-wax mixture can be determined with sufficient accuracy for refinery control purposes by determination of either (*a*) sp. gr. at 65° C., or (*b*) aniline point, or (*c*) refractive index at 65° C. G. R. N.

786. The Glycols and their Derivatives. H. B. McClure. *Industr. Engng Chem.* (News edition), 10.3.39, **17** (5), 149; *Chem. Tr. J.*, 7.4.39, **104**, 335.—The industrial applications of the glycols and their derivatives, of which six of the former and over fifty of the latter are now commercially available, are discussed.

These include: solvent for boric acid in electrolyte condensers; plasticizers for adhesives, for binders in composition cork, and for the polyvinyl acetates used in safety glass; solvents for nitrocellulose lacquers and for water-soluble dyes used in wood stains; worsted lubricant (soluble in water); hygroscopic agent in starch solution, and textile printing pastes; mutual solvents for soaps in mineral oil; dehydration agents for natural gas and constituent of brake fluids. Of the nitrogen derivatives, triethanolamine forms soaps valuable as oil-soluble emulsifying agents in the textile, leather, paper, and other industries. Phenyl ethanolamines are used as intermediates in the synthesis of dyes, whilst ethylene dichloride is the cheapest chlorinated hydrocarbon, is an excellent solvent for oils, fats, waxes, and greases, and is an important constituent of ethyl anti-knock fluid. Dichlorethyl ether is an important lubricating-oil-refining solvent, the glycol stearates and oleates are excellent emulsifying agents, the thiocyanates good insecticides, and the acetates have unusual solvent power. C. L. G.

787. Organic Sulphides: Specific Gravities and Refractive Indices of a number of Aliphatic Sulphides. G. W. Ayers, Jr., and M. S. Agruss. *J. Amer. chem. Soc.*, 1939, **61**, 83–85.—Specific gravities at 0°/4°, 20°/4° and 25°/4° were determined for pure samples of ethyl, *n*-propyl, *iso*propyl, *n*-butyl, *iso*butyl, *n*-amyl, and *iso*amyl sulphides.

Refractive indices at 20° and 25° for the *D* sodium line were also determined for the same sulphides. From these values the molecular refraction values were calculated. W. E. J. B.

788. Action of Aluminium Chloride on Aromatic Hydrocarbons. 1. The 1 : 3-Dimethyl-4-Butylbenzenes. D. Nightingale and L. I. Smith. *J. Amer. chem. Soc.*, 1939, **61**, 101–104.—The four 1 : 3-dimethyl-4-butylbenzenes and 1 : 3-dimethyl-5-*s*.-butylbenzene have been synthesized, and crystalline trinitro-derivatives made of them with the exception of the 1 : 3-dimethyl-4-*iso*butylbenzene.

The 1 : 3-dimethyl-4-*t*.-butylbenzene and the 1 : 3-dimethyl-4-*s*.-butylbenzene both undergo rearrangement on treatment with aluminium chloride to give 1 : 3-dimethyl-5-*t*.-butylbenzene. The identity of the 1 : 3 : 5-hydrocarbon formed by these rearrangements was established by means of melting points of mixtures of the trinitro-derivatives and by freezing points of mixtures of rearrangement product with an authentic sample of the 1 : 3 : 5-hydrocarbon synthesized by the Friedel–Crafts reaction.

The 1 : 3-dimethyl-4-*iso*butylbenzene on treatment with aluminium chloride yields a mixture of hydrocarbons.

The 1 : 3-dimethyl-4-*n*-butylbenzene and aluminium chloride yields 1 : 3-dimethyl-5-*s*.-butylbenzene. W. E. J. B.

789. Viscosity of Solutions of Sulphur Dioxide in Organic Liquids. H. E. Adams and H. E. Rogers. *J. Amer. chem. Soc.*, 1939, **61**, 112–115.—Using a sealed modified Ostwald viscometer, the authors have determined the viscosity of solutions of sulphur

dioxide in carbon tetrachloride, chloroform, and bromoform at 25° C. The densities of these solutions were also determined, and viscosity and fluidity curves for the various solutions have been obtained. In each case an expansion in volume was found on mixing. W. E. J. B.

790. Viscosity of Normal Butanol. G. Jones and S. M. Christian. *J. Amer. chem. Soc.*, 1939, **61**, 82–83.—The authors have determined the density and viscosity of *n*-butanol at 0° and 25° C.

The densities are respectively 0·8246 and 0·8057, whilst the absolute viscosities are 0·05216 and 0·02605 poises. W. E. J. B.

791. Reaction of Thiol Compounds with Aliphatic Olefins. V. N. Ipatieff and B. S. Friedman. *J. Amer. chem. Soc.*, 1939, **61**, 71–74.—Aliphatic mercaptans, thioacetic acid, and hydrogen sulphide add to aliphatic olefins to give good yields of thioethers, thioesters, and mercaptans, respectively. The aliphatic mercaptans and thioacetic acid resemble thiophenol, and differ from hydrogen sulphide in that they add to the olefins more readily and in better yields, and in that they add practically completely in accordance with Markownikoff's rule.

In all cases the yield of addition product increases with increasing branching of the olefins. W. E. J. B.

792. Compressibility of and an Equation of State for Gaseous Normal Butane. J. A. Beattie, G. L. Simard and Gouq-Jen Su. *J. Amer. chem. Soc.*, 1939, **61**, 26–27.—Over a temperature range 150–300° C., the compressibility of gaseous normal butane has been determined.

From the data the constants of the Beattie–Bridgeman equation of state have been determined. For these the paper should be consulted. W. E. J. B.

793. Vapour Pressure and Critical Constants of Normal Butane. J. A. Beattie, G. L. Simard, and Gouq-Jen Su. *J. Amer. chem. Soc.*, 1939, **61**, 24–26.—The authors have investigated the vapour pressure of *n*-butane over a temperature range 75–150° C. During the course of the experiments it was observed that *n*-butane in a glass vessel confined by mercury did not perceptibly decompose at temperatures up to 300° C.

The critical constants of *n*-butane were found to be:

$t_c = 152{\cdot}01 \pm 0{\cdot}01°$ (Int.),
$p_c = 37{\cdot}47 \pm 0{\cdot}02$ normal atmospheres,
$v_c = 0{\cdot}258$ litres per mole (4·44 c.c. gm.),
$d_c = 3{\cdot}88$ moles. per litre (0·225 gm. c.c.).

The uncertainty in the critical volume and density is 1%. W. E. J. B.

794. Hydration of Olefins. V. S. Gutyrya and V. L. Buinitskaya. *Refiner*, 1939, **18**, 83.—A series of experiments are described in which propylene (over 90% purity) was contacted with sulphuric acid varying in concentration from 58 to 94%, at different temperatures either alone or in the presence of one of the catalysts, copper sulphate, phosphoric acid, and silver sulphate. For the non-catalytic series it was found that: (1) the yield of alcohol (*iso*propyl) decreased with increased polymerization of the propylene over the range 90–94% acid; (2) polymerization decreased slowly over the range 90–80% acid, practically ceasing with the 80% acid; and (3) with lower concentration of acid, *i.e.*, down to 58%, the alcohol yield decreased with decrease in acid concentration. Silver sulphate proved to be the best catalyst, but the catalytic effect seemed only to increase the conversion rate in the earlier phases of the reaction. Within the range 34–68° C. the yield of alcohol increased with temperature, particularly rapidly above 50° C. G. R. N.

795. Determination of Coefficients of Friction by Means of the Wilder Oiliness Tester. H. Burstin and E. Katz. *Petrol. Z.*, 1938, **34** (23), 10–11.—The technique employed

with the Wilder Machine (cf. Burstin, *Petrol. Z.*, 1938, **23**, 1–9, Abstract No. 180, 1939) is described in full. Tables of results of repeatability tests show maximum deviations of 1% from mean values.

An investigation of the relationship between oiliness and chemical constitution was undertaken with the machine. Tables of specific gravity, viscosity, pour point, viscosity index, aniline point, wetting number (Irauth and Neyman) and coefficients of friction (μ) are given for successive raffinates and extracts from (*a*) mixed-base crude oil residue, and (*b*) naphthenic crude-oil residue progressively extracted with cresol in each case. It is shown that μ increases with increasing paraffin content. The successive raffinates, however, decreased in viscosity, a factor which the authors were unable to eliminate.

Determinations of μ and wetting number were also carried out on a standard oil alone, and with various admixed polar compounds. Good correlation between decreasing μ and increasing wetting number is shown. C. G. G.

796. Rôle of Free Radicals in the Oxidation of *n*-Heptane. R. Maass. *Oel u. Kohle*, 1939, **15**, 299–306, 321–326.—It has been observed that there is definitely a parallel between the knocking properties of a hydrocarbon, its thermal stability, and its tendency to oxidize, and a chain reaction has been suggested by several authors as the reaction responsible for knocking. These chains are held to be caused by free radicals which are formed initially by very slight decomposition of the hydrocarbon itself, and it must be assumed that they have a long enough life to lead to a vigorous reaction at a temperature at which the true thermal decomposition of the hydrocarbon itself is immeasurably slow. The object of this work was to investigate from a qualitative standpoint whether a marked acceleration of the rate of oxidation occurs through the artificial introduction of free radicals, and thereby prove the existence of the chain reaction mechanism.

Evidence is quoted from the literature to show that free radicals are produced by the thermal decomposition of azomethane, and by the photochemically induced decomposition of azomethane and of acetone. Accordingly, azomethane or acetone was mixed with *n*-heptane, and submitting the activating agent to the required treatment to produce the free radicals, the decomposition of the heptane was observed at constant temperature and volume by measuring the increase in pressure in the reaction vessel. Above a minimum temperature and pressure of *n*-heptane, the pressure increase due to the decomposition induced by the thermal decomposition of azomethane is three times that due to the decomposition of the azomethane itself. Over the temperature range investigated *n*-heptane alone is thermally stable. Under these conditions the reaction is of the second order with respect to the azomethane and of zero order with respect to the heptane, above a minimum pressure.

From the variation of reaction velocity (reciprocal of the time required for a pressure increase of 60 mm. Hg) with temperature the activation energy is calculated as 50 ± 4 Cals., in good agreement with the two values in the literature for the activation energy of the decomposition of pure azomethane, a fact which shows that the decomposition of the heptane is independent of temperature.

Observations on the oxidation of *n*-heptane induced by free radicals from azomethane and acetone were all made at temperatures below those at which there is measurable interaction between *n*-heptane and oxygen. The induced oxidation varies greatly with temperature, but the photo-oxidation of acetone and of azomethane is practically independent of temperature. An activation energy of 12·1 Cals. and 20·5 Cals. respectively, is calculated for the oxidation induced by azomethane and acetone.

The reaction is (at least in part) heterogeneous, since the state of the wall is of very great influence on the reaction velocity. Since the reaction at comparatively low temperatures (less than 250° C.) after a short induction period can lead to an explosion, a chain reaction is also to be expected on this account. Addition of nitrogen greatly accelerates the rate of reaction; this is to be explained on the assumption that reaction chains start in the gas phase and are broken at the walls.

The combustion does not go completely to CO_2 and H_2O; besides CO, which is observed in varying amounts, other intermediate products must be assumed.

T. T. D.

797. Chemistry and Mechanism of the Pyrolysis of Ethylene (Method for the Production of the Technically Important Butadiene) Part I. M. Schultze and G. R. Schultze. *Oel u. Kohle*, 1939, **15**, 193–198.—The polymerization of olefines is of increasing importance in the manufacture of numerous classes of organic compounds. By investigating the polymerization of ethylene, the authors hope to throw light on the basic principles involved in the polymerization of higher homologues, and although they find even this reaction to be very complicated, they feel that they have largely explained its mechanism.

The pyrolysis was observed first in a quartz vessel at constant volume. The ethylene used was purified from propylene by washing with sulphuric acid, and then passed into the evacuated apparatus, where it was condensed with liquid air. Permanent gases were pumped off under high vacuum, the residual ethylene adsorbed on active carbon at a low temperature, and any ethane pumped off at the temperature of solid CO_2. Some of the ethylene was then vaporized into a 2-litre flask, and released through a Bodenstein cock into the quartz reaction chamber, which was connected to the rest of the apparatus by capillary tubing (volume $< 0{\cdot}5\%$ of the reaction vessel). The apparatus was then heated electrically to the desired temperature ($\pm 1°$ C.), and the variation of pressure with time measured on a Bodenstein manometer.

The results of numerous experiments are given, and it is deduced that at pressures > 1 at. and at temperatures $< 800°$ K., the chief reaction is $2C_2H_4 \rightarrow C_4H_8$. The latter product is itself thermally unstable, so that as the reaction proceeds the condensation of C_4H_8 itself becomes increasingly important. At lower pressures and higher temperatures the reaction is essentially one of decomposition into aliphatic and aromatic compounds, which finally yield coke, H_2, CH_4, C_2H_2, etc. In the region where the simple dimerization takes place the reaction is essentially homogeneous and of the second order; it is strongly catalysed by traces of oxygen, and shows a large steric factor. T. T. D.

798. Chemistry and Mechanism of the Pyrolysis of Ethylene. Part II. M. Schultze and G. R. Schultze. *Oel u. Kohle*, 1939, **15**, 215–220.—In order to isolate the unstable and reactive intermediate products it is necessary for the reaction time to be very short and for there to be some method of "freezing" the reaction products. To satisfy these requirements a streaming system must be used. Purified ethylene diluted with purified nitrogen was passed at a high velocity through a strongly heated quartz tube; immediately after leaving the furnace the tube was enclosed by a condenser through which cold water was circulated. All condensable products were then quantitatively removed from the gas stream and isolated for later analysis by cooling with liquid air. Methane and hydrogen were oxidized by passing over copper oxide and the carbon dioxide and water estimated, whilst the residual gas consisting only of nitrogen escaped to the atmosphere.

The principle of the analysis consists in fractional distillation into C_2, C_3, C_4, C_5 and C_6 and higher fractions. Preliminary work showed that the first three fractions contained only acetylene, ethylene, ethane, propylene, and butadiene.

Acetylene was estimated by the method of Treadwell and Tauber, ethylene by shaking with bromine water in the dark, the rest of the C_2 fraction assumed to be ethane and confirmed by oxidation to carbon dioxide and water; propylene was estimated by shaking with bromine water and oxidation. The C_4H_6 was identified by hydrogenation at 100° C. to C_4H_8 followed by hydrogenation at 200° C. to C_4H_{10} and also confirmed by oxidation to carbon dioxide and water. By comparing the vapour-pressure curve of this fraction with those of the various isomeric C_4H_6 compounds, the authors identify their product as 1 : 3-butadiene, a conclusion supported by further physico-chemical evidence.

The C_5 fraction was almost entirely absent, and the C_6 fraction shown to be essentially benzene by vapour-pressure and refractive-index measurements. Traces of styrene and naphthalene were also detected in the residual higher fractions.

The authors direct attention to the pyrolysis of ethylene as a possible method of manufacture of 1 : 3-butadiene, which is of great importance as a starting material for the preparation of synthetic rubber. T. T. D.

799. Chemistry and Mechanism of the Pyrolysis of Ethylene. Part III. M. Schultze and G. R. Schultze. *Oel u. Kohle*, 1939, **15**, 233–241.—In the static system butene

is the primary product, in the streaming system butadiene is the only C_4 product obtained. This is to be attributed to the fact that the former system was observed at 500° C., whilst 780° C. was the lowest practicable temperature for observations on the latter.

The data obtained from the dynamic system were critically examined, and tables and diagrams are given showing the dependence of the amount of ethylene reacting on the rate of flow through the furnace at different temperatures; the dependence of the velocity constants of the decomposition on temperature; of the relative amounts of the various decomposition products on the rate of flow at different temperatures; of reaction products on the degree of dilution of the ethylene.

Runs were also made with the ethylene replaced by ethylene and butadiene; pure 1 : 3-butadiene; acetylene and ethylene; acetylene and butadiene. The data obtained for these reactions were used in conjunction with the figures obtained on the decomposition of ethylene to evolve a complete scheme for the latter reaction. This scheme, which involves ten simultaneous reactions, is critically discussed, and is used for the calculation of the velocity constants, and approximate heats of activation of the various primary and secondary reactions. T. T. D.

800. Catalytic Cyclization of Aliphatic Hydrocarbons. B. L. Moldavski, G. D. Kamusher and M. V. Kolylskaya. *Refiner*, 1939, **18** (3), 118.—Several low-boiling aliphatic hydrocarbons were separately passed over chromic oxide in a glass tube heated in an electric furnace. The liquid reaction products were analysed for unsaturation by the bromide–bromate method, and aromatics were determined by sulphuric-acid absorption. Normal octane at 460° C. gave a product containing 63% *o*-xylene, whilst normal heptane gave 26% toluene at 470° C. Similarly, the liquid products given by normal hexane, di*iso*butyl, an octene mixture, di*iso*amyl and cetene contained 17% benzene, 36% *p*-xylene, 43% *o*-xylene, 82% *m*-methyl*iso*-propylbenzene and 100% high-boiling aromatics, respectively. The gas produced in the reaction was chiefly hydrogen in some cases amounting to over 90% of the gas formed. In the case of normal hexane, however, the gas contained an appreciable amount of lower paraffins, viz. 23·2%. In every case the liquid product contained no fractions boiling below the starting material. In every case the aromatic hydrocarbon obtained had the same number of carbon atoms as the aliphatic hydrocarbon from which it was prepared. The work is being continued. G. R. N.

See also Abstract No. 835.

Analysis and Testing.

801. Ways of Analyzing Crude Oil Data. W. L. Nelson. *Oil Gas J.*, 4.5.39, **37** (51), 52.—Three methods are described for the analysis of crude-oil data to determine yields and properties of products, based on laboratory data on Rodessa crude. A 3-litre sample is distilled in a true-boiling point equipment and the condensate collected as 100-c.c. fractions, which are examined for the usual properties. The methods of plotting these properties are :

1. *Mid per cent. and Yield Curves.*—The figures for the particular properties (*e.g.*, octane number, A.P.I. gravity, viscosity at 100° F. and at 210° F.) of each fraction are plotted against the mid percentage point of the particular portion (slight modifications are required for sharply curving portions of the curves). Yield curves (*e.g.*, for octane number and viscosity at 210° F.) are obtained by preparing a series of blends of fractions and determining the properties of these blends. From these the yield of each blend against its octane number or viscosity *is* plotted.

2. *Iso-property Curves.*—The graph used for this method has as abscissa the percentages corresponding to the beginning of the fraction the properties of which are known, and as ordinate that corresponding to the end of the fraction. On a diagonal line across the chart are plotted the particular properties of the fraction. Thus for a 0-30% gasoline cut with an octane number of 40, a perpendicular is dropped from 30% on the ordinate to the diagonal and the intersection becomes 40 on the scale, whilst a similar line dropped from the 20% on the ordinate becomes 50% on the scale. Similarly, data for the gravity of intermediate cuts or viscosity of cylinder stocks may be constructed, preferably on separate charts.

3. *Property Scale Curves.*—In this method the distillation curve (or any other property curve) is plotted as the fundamental curve and additional scales prepared along the vertical axis by marking the values of the properties at the corresponding percentages distilled. Interpolation is, however, rather difficult, owing to the non-uniformity of the vertical scales. C. L. G.

802. Determination of Salts in Crude Oil. Part III. C. H. M. Roberts, R. W. Stenzel and W. F. Ebertz. *Petrol. Engr*, March 1939, **10**, 42.—For determining the plugging and corrosive properties of a crude oil a chloride determination is insufficient and complete analysis of the aqueous extract is desirable. For chloride the Volhard method is recommended, nitrobenzene being added to avoid filtration. Calcium and magnesium are determined individually as oxalate and phosphate or together by a modification of the soda reagent method, in which they are precipitated together, dissolved in a known amount of perchloric acid, and the excess titrated with standard alkali. Sulphate is determined by barium precipitation. Results are expressed in lb. per 1000 brls. The hypothetical combinations are computed in the order of corrosiveness. All magnesium (including aluminium and iron) is calculated as chloride. Calcium and alkali chlorides are then reported. If the chloride is not equivalent to all the cations, it is combined in this order, the sulphates, carbonates, etc., being assigned to the alkalis.

The total ash is determined by evaporation, followed by gentle ignition to a carbonaceous mass. This mass is then sulphated, to avoid loss of volatile chlorides, before ignition to constant weight. The water-soluble solids are similarly treated after evaporation of the aqueous extract to dryness. Centrifugable solids are determined by centrifuging a solution of the crude oil in an equal volume of xylol after warming to 140° F. The precipitated solids are washed successively with xylol, acetone, water, and acetone, and finally dried and weighed. R. J. E.

803. Determination of Salts in Crude Oil. Parts IV and V. C. H. M. Roberts, R. W. Stenzel and W. F. Ebertz. *Petrol. Engr*, April 1939, **10**, 144 and May 1939, **10**, 65.—The acidity of crude oils is classified into free acidity (strong and weak) and potential acidity. Strong acidity is due to acidic treatment in production, whilst weak acidity consists of phenolic and naphthenic acids. Potential acidity (HCl) is evolved on distillation and approximates to that generated in distillation equipment. It is determined by steam distillation to 650° F. Results of this test show that the hydrolysis of chlorides in terms of HCl are: sodium chloride negligible, calcium chloride 2%, and magnesium chloride 50%. Hydrolysis may, however, be much greater in the presence of free acidity. For the determination of free acidity various conventional titration methods were found to be unsatisfactory and a potentiometric method was adopted. The titre giving a p_H of 7 is taken as a measure of the strong acidity and a p_H of 11·0 or 11·5 as the end-point for weak acidity.

Hydrogen sulphide is determined by the steam-distillation method used for potential acidity. Separation from mercaptans is effected by adjustment of the p_H to 9·3, so that mercaptides are insoluble in water. Sulphide and chloride are determined together by the Volhard method. The chloride is determined alone after boiling with acid to remove sulphide. The apparatus used for the steam distillation is clearly illustrated. R. J. E.

804. Influence of Atmospheric Pressure on Fuel Testing. Kessler. *Oel u. Kohle*, 1939, **15**, 255–263.—The ignition properties of five diesel fuels and four gasolines have been thoroughly investigated and shown to vary considerably with atmospheric pressure. Properties directly measured were the variation of self-ignition temperature with rate of oxygen flow at different altitudes and the variation of ignition delay with altitude. The results of these measurements and figures derived from them are given in four tables of results and fifteen diagrams. Measurements were made at different altitudes up to 2600 m., and from the data obtained variations in the properties of other fuels with pressure can be estimated.

It is claimed that the results obtained in this way correlate well with American work in which the knocking of fuels of different octane numbers was investigated in the engines of cars driven at altitudes of up to 12,100 ft. T. T. D.

805. Method of Gasoline Analysis. V. Schneider, G. W. Stanton and E. Watkins. *Refiner*, 1939, **18** (3), 112.—The gasoline is fractionally distilled into narrow cuts using an efficient column. The volume, refractive index at 20° C., the specific gravity at 25° C. and the amount of unsaturation (bromide–bromate method) are determined for each cut. With the aid of numerous charts giving the above properties of pure hydrocarbons and a graph relating specific gravity and refractive index, the respective contents of paraffins, naphthenes, and aromatics in the fractions are obtained by solving three derived simultaneous equations of the first order. A feature of the method is a graph giving recommended empirical corrections on specific gravity and refractive index which allow for expansion on mixing two or more types of hydrocarbons. G. R. N.

806. Analyses of Oil-field Waters from the Carpathians and their Foreland. III. M. Kleinman. *Przem. Naft.*, 25.2.39, (4), 93–98.—This is the third series of analyses of salt waters from Polish oil-fields. Their object is the geological correlation of different fields, as well as scientific control of the oil-water composition in connection with rational exploitation of the well. Accordingly special attention was paid to the occurrence of such ions as I, Br, Ba, Sr, Mn, which might be important from the geochemical point of view.

The results are tabulated in comprehensive tables, the analyses of some waters being illustrated by Krejci-Graf and Corps diagrams. E. J. W.

807. Composition of some Roumanian Straight Run Gasolines. C. D. Nenitzescu and A. Constantinescu. *J. Inst. Petrol.*, 1939, **25**, 149–167.—Three Roumanian gasolines were fractionally distilled in a Fenske column into 1° C. cuts. The estimation of the aromatics, naphthenes, and paraffins in each cut was carried out by the usual methods. G. R. N.

Motor Fuels.

808. Blending of Motor Fuels. W. B. Engelbrecht, H. M. Trimble and H. I. Hoover. *Oil Gas J.*, 4.5.39, **37** (51), 46. (Paper presented before Nat. Gas. Assoc. of America, Tulsa, May, 1939.)—Recent increases in the octane rating of U.S. third-grade gasolines and the trend of refiners towards seasonal control of volatility have led to the study of data on the blending of fuels with a view to the provision of suitable charts for determining the characteristics of blends.

Charts are reproduced, based on laboratory blending data, showing the vapour pressures and distillation characteristics of blends of components ranging from 0 to 25 lb. Reid vapour pressure. Data are also presented to show the financial savings owing to lower T.E.L. requirements resulting from the use of natural gasoline in the manufacture of 67 octane-number gasoline. C. L. G.

809. Manufacture of *iso*-Octane. L. J. Coulthurst. *Oil Gas J.*, 27.4.39, **37** (50), 50.—A description is given of a process for the manufacture of *iso*-octane by the selective catalytic polymerization of caustic-treated depropanizer bottoms (butane–butene) from cracked gasoline, followed by hydrogenation.

To eliminate sulphur poisoning of the catalyst the butane–butene fraction is treated with caustic soda in three stages. In the selective catalytic polymerization process *iso*- and normal butane form several isomers, among which are 2 : 2 : 4-trimethylpentenes 1 and 2, the co-polymers giving on hydrogenation a product of equal octane blending value to *iso*-octane. The treated butane–butene stock is pumped to a steam-heated preheater and passed downward through each of three polymer reactors in series, containing an extruded type catalyst. To remove the heat of reaction of polymerization of butenes to octenes, and thereby keep the reaction selective, water at boiling point is circulated through the shell side of the reactors. The product from the reactors is passed to a debutanizer, where excess butanes and unreacted butenes are separated overhead and used as reflux, cycle stock, or refinery blending components. The polymer bottoms after leaving the reboiler are hydrogenated to obtain maximum yield of the *iso*-octane product or, to obtain a better quality *iso*-octane, the *iso*-octene is segregated in a fractionating column for hydrogenation. Owing to the relatively high cost of hydrogen at this plant, hydrogenation is effected in two stages. In the first stage the octenes are heated in a steam preheater and treated

with unreacted hydrogen from the second stage in a series of catalyst tubes. The partly reacted mixture is again preheated and passed through the second series of catalyst tubes, the shell containing which is water cooled. The *iso*-octane is condensed from the resulting vapours, and the surplus hydrogen passed back to the first-stage reactor. The heat requirements of all three processes are reduced to a minimum by the use of the heat released during the exothermic polymerization reactions to generate steam. C. L. G.

810. Patents on Motor Spirit. N. V. de Bataafsche Petroleum Mij. E.P. 502,448, 17.3.39. Appl. 9.5.38. Removal of mercaptans from hydrocarbons or derivatives by means of an alcoholic solution of an alkali metal hydroxide. The alkaline sludge is regenerable by oxidation.

Phillips Petroleum Co. E.P. 502,752, 24.3.39. Appl. 23.10.37. Sweetening of oil containing mercaptans by contacting it in the liquid form in admixture with a gas containing free oxygen, with an adsorbent material impregnated with an aqueous solution phase containing cupric ions and chlorine ions.

G. W. Johnson and I. G. Farbenindustrie A.-G. E.P. 503,602, 6.4.39. Appl. 6.9.37. Production of anti-knock motor fuel by subjecting to vapour-phase cracking at 400–700° C., oils consisting wholly or substantially of unsaturated aliphatic hydrocarbons boiling above the boiling point of benzine, while adding mono-nuclear aromatic hydrocarbons.

N. V. de Bataafsche Petroleum Mij. E.P. 503,644, 12.4.39. Appl. 30.12.37. Removal of mercaptans from hydrocarbon mixtures using an aqueous alkaline solution together with a solubility-promoting agent, *e.g.*, alkaline salt of α-amino*iso*-butyrate or α-hydroxyvalerate or α-aminovalerate.

N. V. de Bataafsche Petroleum Mij. E.P. 503,645, 2.4.39. Appl. 30.12.37. Process as described in E.P. 503,644 for removing mercaptans from hydrocarbons in which the promoting agent is an alkali salt of phenylacetic acid or a substituted phenylacetic acid containing one neutral or basic polar group.

Kodak Ltd. E.P. 503,316, 3.4.39. Appl. 1.7.37. Stabilization of motor spirit by adding *N* (primary normal butyl) or *N* (alkyl-substituted primary normal butyl) *p*-aminophenol.

Kodak Ltd. E.P. 503,401, 3.4.39. Appl. 1.7.37. Stabilizer for motor fuel prepared by eliminating water from a reaction mixture of a polyhydric phenol containing at least two phenolic hydroxy groups in *ortho* or *para* position to one another, and a primary or secondary alkyl primary amine containing at least 4 C atoms. W. S. E. C.

See also Abstracts Nos. 767 and 841.

Kerosine.

811. Investigation of Power Kerosines. Z. V. Veksler and P. A. Kudryavtsev. *Neft. Khoz.*, February 1939, **20** (2), 41–45.—The tests were carried out in order to find the necessary volatility and detonating characteristics of Baku commercial power kerosine ensuring satisfactory operation of STZ and KhTZ tractor engines (both being modified International Harvester Co. engines—L.R.). From Baku commercial kerosine (30% distilling at 200° C., F.B.P. 315° C., octane number 39) six fractions were prepared: (1) up to 160° C., (2) 160–200° C., (3) 200–240° C., (4) 240–280° C., (5) 280–300° C., (6) above 300° C. Fractions (1) to (4), three blends prepared from the fractions, and two commercial power kerosines were tested.

Each fuel was examined in 15-hr. runs of an S.T.Z. engine operating on the bench at 28 h.p. and 1000 r.p.m. In the crank-case a blend of 80% machine lubricating oil and 20% brightstock, $E_{50} = 10{\cdot}3$, was used. No oil was added during operation, and at the end of each test the oil was examined for dilution.

Results of tests are given in tabular form. It has been found that the temperatures of distillation of 50% and 70% kerosine are related to the amount of oil dilution.

Although, to suppress detonation, between 6 and 9 lb. water had to be injected into

the combustion chamber, in all cases only insignificant quantities of water (up to 0·8%) were detected in the used crankcase oil.

It is concluded that for operation without water injection an octane number between 49 and 52 would be necessary. Generally available power kerosines in the U.S.S.R. having about 40 octane number make injection of about 3 litres water per hour necessary. To ensure a minimum limit of viscosity of $E_{50} = 3{\cdot}5$ after 15 hr. of operation, 70 (50)% of the kerosine used should not distil at temperatures higher than 240 (220)° C. L. R.

Gas, Diesel and Fuel Oils.

812. Gas—Compulsory Fuel for German Buses. Anon. *Petrol. Z.*, 1939, **35**, 334–335.—A new decree in Germany forbids the use of liquid fuels for all buses with sixteen passenger seats or more and with Otto or carburettor engines on or after 1st October, 1939. The number of buses is given as 17,000, including 7000 diesel buses, so that about 10,000 vehicles are concerned. The decree orders the use of liquefied gas as fuel—a mixture of butane and propane—which is a by-product of the petrol synthesis. The biggest difficulty will be the supply of gas all over the country, and an exception is therefore being granted for buses in places of less than 20,000 inhabitants. But until 1st October of this year every town with more than 20,000 inhabitants will have a station where empty containers can be exchanged for filled ones, and it is claimed that the fuel will also always be available after this date. E. W. S.

813. Stability of Fuel Oils. J. Herbrich. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 597–602.—Fuel oils used in France are classified as follows :—

(*a*) Mixtures of light fuel oil with gas oil, to a low viscosity, used for small central-heating plants and for small stationary diesel engines.

(*b*) Mixtures or straight residues of medium viscosity used for medium-sized burners or large diesel engines.

(*c*) Heavy fuels of high density used for large furnaces and generally preheated.

(*a*) tend to throw down deposits of asphaltenes liable to choke jet filters. A quantitative measure of this tendency by filtration through a standard-sized sieve is described and results are quoted for various oils. The use of heavier gas oils or gas oils of high solvent power for asphaltenes is recommended.

(*b*) tend to separate paraffin wax at low temperatures. Improvements may be effected by blending in heavy gas oil and using heavier residual oil to maintain the viscosity.

(*c*) give carbonaceous deposits due to use of cracked residues. Sediment content before and after certain heat treatments gives a measure of this tendency. Microscopic methods are also described. J. C.

814. Stability of Fuel Oil. M. Louis. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 607–612.—Below certain critical temperatures fuel oils acquire pseudo-plastic properties, and precautions are necessary in the determination of viscosities at low temperatures.

Fuel oils form stable emulsions with 70–80% of water. These sediment to the bottom of the tank and may be mistaken for deposits. These emulsions have viscosities greatly in excess of that of the oil itself, are also pseudo-plastic, and sometimes impede diffusion when blending.

Fractional distillation in vacuum shows that asphaltic bodies tend to remain in the residues and do not pass over with the distillate, and that it is difficult to distil fuel oils above 250° C. without decomposition.

Certain treatments, such as cracking, cause instability. In particular the oils absorb oxygen at ordinary temperatures and pressures. The amount of oxygen and the rate at which it is absorbed vary greatly with the age, condition, and previous history of the sample, as well as with its origin.

On mixing two fuel oils a slight increase on the calculated amount of asphaltenes in the resulting mixture may be obtained. This increase is most apparent when gas oil is used as diluent.

The ageing of the fuel oil is accelerated by rise in temperature being slight below 100° C. and rapid at 140° C. M. I.

815. Sedimentation by Physico-Chemical Flocculation of Cracked Fuel Oils. M. E. Fouret. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 603–606.—The tendency of mixtures of fuel oil containing cracked residues to flocculate is due to the cracked fuels, but flocculation occurs only under certain conditions.

The Wilmington Heat Test gives a simple means of studying these conditions, and throws light on the physico-chemical changes which take place in these mixtures.

M. I.

816. Contamination of Fuel Oil by Water and Combustion of Contaminated Oils. M. Legendre. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 613–617.—Fuel oils used by the Navy are often contaminated with water, with which they form stable emulsions.

The effects of temperature and of physical properties of the oils on the emulsification of demulsification properties are described.

Oils contaminated with water up to 40% can be used in boiler burners without damage to burners or feeding system. M. I.

817. Continuous Purification of Water-Contaminated Oils. A. Pamula. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 619–621.—Crudes containing water and solid impurities which cannot be separated by decantation can be purified by a continuous distillation process carried out in a specially adapted Dubbs cracking plant.

The oil is heated to 190° C. and introduced into a column under a pressure of 13 atmospheres. Solid contaminants are separated in part, and are drawn off at the bottom of the column. The oil is passed into a second column, where, at a temperature of 240° C. and at a pressure of 0·1 atmosphere, the remaining impurities are removed. M. I.

818. Ash Contents of Fuel Oils. A. Merlin. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 623–631.—The ash of fuel oils consists partly of natural impurities and partly of impurities introduced by industrial processing. In certain circumstances it can be very destructive to the refractory linings of combustion chambers. Chemical analysis enables a forecast of the detrimental effect to be made. Sodium sulphate and vanadium are particularly destructive. Methods for analysing the ash are given. Making the surfaces of the refractory bricks perfectly smooth by coating with a refractory cement prevents capillary penetration by the fused ash and is the most effective protection for the bricks. R. G. G.

Lubricants and Lubrication.

819. Surface Tensions of Lubricating Oils. M. Freund. *Petrol. Z.*, 1939, **35**, 295–300. – Surface tension of all hydrocarbon oils is an important factor in all manufacturing processes in connection with heat convection to walls and fractionating, and it would be a definite advantage to establish a relation between other known quantities and surface tension of the oils, but so far this has only been possible for some simply built hydrocarbons of low molecular weight. With lubricating oils the surface tension certainly has a connection with the lubricating value, but so far only a few measurements have been made. The author has tried to find out if there is some relation between the molecular weight and the surface tension of lubricating oils, or if the law of Eoetvoes is valid for these oils. From the results given it appears that no definite relations can be established for the following reasons : the lubricating oils are mixtures of very different hydrocarbons, the form, size, and structure of the molecules being widely divergent. So it would be necessary in each case to know the molecular weight of all the components of the oil concerned, and even then it would be impossible to find the Eoetvoes-constant, because these big molecules are again different in their behaviour against the same surfaces according to their inner structure. E. W. S.

820. Electrodeposition of Lubricants from Aqueous Dispersions. R. O. Williams. *Industr. Engng Chem.*, 1939, **31** (6), 725.—Electrodeposition is an effective method for forming or depositing lubricant films on wire or other metallic surfaces. The nature of the lubricating properties of such films resulting from electrodeposition depends to a great extent on the physical nature of the film. H. E. T.

821. Lubrication of Ammonia—and Carbon Dioxide Refrigeration Plant. P. A. Graf. *Petrol. Z.*, 1938, **34** (23), Supp. 4–6.—The functions and requirements of the lubricant are discussed. C. G. G.

822. Journal Lubrication Friction Coefficients in the Thin Film Region. J. E. Hedrick and R. R. Freeman. *Refiner*, 1939, **18**, 101.—Data are presented on the friction coefficients, seizure points, and wear for partial journals. A modified Timken machine was used, the pressure being varied from 800 to 23,000 lb. per sq. in., whilst the temperature range employed was 70–400° F. An Oklahoma oil, SAE 30 grade was used, and its Saybolt viscosities and V.I. were 578 secs./100° F., 63·2 secs./210° F. and 77, respectively. The influence of 2 : 4 : 6-trichlorophenol and dichlormethyl stearate as addition agents was studied. For steel bearings the latter compound lowers materially the friction and increases the seizure load, but wear also increases. The trichlorophenol reduced the amount of wear, but otherwise was inferior to the stearate. The effect of the roughness of the bearing surfaces on the performance is discussed, and a short review of other work on the subject is given. G. R. N.

823. Patents on Lubricating Oil. Standard Oil Development Co. E.P. 502,335, 15.3.39. Appl. 23.9.38. Improved lubricating oils for use in diesel engines which contain small amounts of a metallic soap of Al, Ca, Ni, Sn, or Mg obtained from products of the oxidation of "sweater oil" by steam distillation under a pressure of 4 mm. Hg.

N. V. de Bataafsche Petroleum Mij. E.P. 503,177, 26.3.39. Appl. 26.8.37. Preparation of improved lubricants for use at high pressures and temperatures and at high speeds, by the addition of a small quantity of oil-soluble organic compounds as specified.

Standard Oil Development Co. E.P. 503,575, 11.4.39. Appl. 9.4.38. Solvent extraction of hydrocarbon oils using as solvent an extract phase obtained in the extraction of a paraffinic-type oil with a solvent having a preferential solvent power for naphthenic and aromatic hydrocarbons.

G. W. Johnson and I. G. Farbenindustrie A.-G. E.P. 503,595, 3.4.39. Appl. 3.8.37. Manufacture of viscous condensation products from diolefines and olefines using boron fluoride as condensation agent.

Texaco Development Co. E.P. 503,886, 17.4.39. Appl. 20.4.38. Solvent refining of hydrocarbon oils using furfural in the presence of a mixture of *ortho*- and *para*-chlorphenol.

E. Eichwald. U.S.P. 2,153,116, 4.4.39. Appl. 26.7.37. Solvent extraction of mineral oil by means of furfural to produce a lubricating oil of low Conradson carbon residue.

M. H. Tuttle. U.S.P. 2,153,353, 4.4.39. Appl. 20.7.32. Separation of residual mineral-oil stock without preliminary precipitation of asphalt by means of propane or nitrobenzene, etc.

D. S. McKittrick and H. J. Henriques. U.S.P. 2,153,895, 11.4.39. Appl. 20.6.36. Dewaxing of hydrocarbon oils using a mixture of isopropyl alcohol and 1 : 2-dichloroethane.

J. W. Weir. U.S.P. 2,154,189 and U.S.P. 2,154,190, 11.4.39. Appl. 8.6.36. Solvent extraction of hydrocarbon oils using a solvent of the pyridine class and its homologues which does not react with alkalis in the presence of aqueous metal hydroxide solutions.

E. A. Bösing. U.S.P. 2,154,372, 11.4.39. Appl. 2.6.38. Solvent refining of hydrocarbon oils using solvents of the pyridine class and potassium nitrite or sodium hydrosulphide dissolved in water.

G. R. Bond, Jr. U.S.P. 2,154,434, 18.4.39. Appl. 27.8.35. Method and apparatus for decolorizing and refining lubricating oils using adsorbent substances.

M. B. Cooke and E. J. Patty. U.S.P. 2,154,493, 18.4.39. Appl. 21.2.35. Deasphalting and dewaxing lubricating oils by means of propane.

L. P. Evans. U.S.P. 2,155,644, 25.4.39. Appl. 19.2.37. Solvent refining of hydrocarbon oils using furfural.

L. P. Evans and H. H. Gross. U.S.P. 2,155,645, 25.4.39. Appl. 24.2.37. Dewaxing of hydrocarbon oils using an aliphatic ketone and benzol at 100–120° F. in the presence of a wax crystal modifying substance, *e.g.*, aluminium stearate.

C. R. Wagner and W. A. Raine. U.S.P. 2,155,745, 25.4.39. Appl. 1.7.35. Preparation of lubricating oil by cracking a paraffin base bright stock and blending the distillate with a major portion of dewaxed wax distillate, and reducing the blend to the desired viscosity, flash point, and fire tests. W. S. E. C.

Asphalt and Bitumen.

824. Some Asphalts from Oregon Basin (Wyoming) Crude Oil. K. E. Stanfield. U.S. Bur. of Mines, R.I. 3435, March 1939.—A description is given of the apparatus and method used by the Bureau of Mines for the production of asphalts from Oregon Basin (Wyoming) crude oil. Full data on the properties of the asphalt and a discussion of the susceptibilities according to different factors are given.

The crude oil had the following properties: Specific Gravity 0·926; Sulphur 3·37%, Visc. S.U. at 100° F. 300 sec.; Pour Point below 5° F.; and on a Hempel distillation gave the following yields of products: light gasoline, 4·0%; total gasoline and naphtha, 15·8%; kerosine distillate, 3·4%; gas oil, 13·5%; non-viscous lub. distillate, 9·9%; med. lub. distillate, 7·4%; visc. lub. distillate, 4·9%; residuum, 44·4%.

The yields of asphalt were determined by distillation of the crude oil in a glass flask without fractionation under atmospheric pressure to a temperature of 225° C., followed by distillation under 2/3 mm. mercury absolute pressure to the required grades. Yields by weight of asphalt were as follows: 19 pen. 142° F. Soft. Pt., 35·3%; 37 Pen. 130° F. Soft. Pt., 39·7%; 69 Pen. 120° F. Soft. Pt., 42·7%; 119 Pen. 111° F. Soft. Pt., 45·2%; 208 Pen. 99° F. Soft. Pt., 48·4%, and a softer grade 98 Pen. (at 60° F.) 93° F. Soft. Pt., 48·6%. The yield of 100 Pen. with 115° F. Soft. Pt. is estimated at 44·6%.

Some of the grades were slightly cracked, but no indication of heterogeneity was given by the Oliensis Spot Test.

The asphalts are characterized by high sulphur contents (4·62–5·03%), 100% solubility figures, slow losses on heating (with the exception of one which had undergone cracking) and high ductilities at 77° F.

From the temperature susceptibility data provided it is concluded that these asphalts are similar in this respect to commercial grades from Mid-Continent oils; but have greater temperature susceptibilities than those reported for Mexican and Venezuelan asphalts and lower susceptibilities than those reported for Californian asphalts. C. L. G.

825. Rapid Determination of Soluble Bitumen in Road Carpets. L. J. Chalk. *J. Inst. Petrol.*, 1939, **25**, 168–177.—Two methods are described. In the first hot extraction of the sample is carried out in simple apparatus and the bitumen is determined by difference. In the second method a known volume of solvent is added to the sample, and after solution of the bitumen by agitation in the cold, an aliquot portion of the solution is evaporated and the bitumen is determined by direct weighing. G. R. N.

826. Asphalts obtained from Argentine Petroleum. A. Zanetta. *Bol. Inform. Petroleras*, February 1939, **16** (174), 3–11.—Of the four oil-bearing zones in the Argentine, only two—namely, (*a*) Chubut (Comodoro Rivadavia) and (*b*) Neuquen (Plaza Huincul)—produce an asphaltic residue after distillation *in vacuo* or *in vacuo* and steam, suitable for road-making. The percentages of asphalt relative to the total bulk of crude oil are for (*a*) 35–38%, and for (*b*) 15–17%. Characteristics of these are given and compared with other well-known asphalts. Attention is directed

to the fact that at the distillery at La Plata 2000 tons per month of residue is produced, perfectly suitable for road work, but is not used because it does not comply with an out-of-date specification. This residue is suitable as a base for preparing road oils, such as Tracam. H. I. L.

827. Asphalt Rubber Mixtures for Road Construction. J. A. Plaizier. *Wegen*, 1939, **1**, 1–3.—The article describes the levelling of asphalt concrete with a mixture of fine aggregate, cutback, and rubber powder.

The purpose of this treatment is to make the cheap and durable asphaltic concrete suitable for city streets.

The disadvantage, from a hygienic or an æsthetic point of view, of the numerous little holes in the surface is thereby eliminated. A surface treatment is less effective, owing to dust formation and loosening of tar chippings.

A mixture of 100 parts by weight of fine sand, chippings, or clinker and filler with 7–8 parts of cutback shows only a little cohesion after rolling, unless only small quantities are applied. In this case, however, not all holes are filled.

More cohesion is obtained by using more bitumen, but at the same time the surface will often become soft and slippery until the flux has evaporated from the cutback.

Fine rubber powder absorbs the flux of the cutback in the course of about 12 hr.

Since 1934 several road patches have been treated with rubber-containing mixtures. On the first patch (4 years old) the topsheet is still unimpaired.

After some experiments the following mixture has been applied :

85	parts	by	weight	of river sand.
15	,,	,,	,,	,, filler.
12	,,	,,	,,	,, cutback 150–200 visc.
0·6	,,	,,	,,	,, rubber powder.

After the roller has gone once over the warm asphaltic concrete, the cold rubber-containing mixture is spread in a quantity of 6 to 7·5 kg./sq. m.

The mixture has to be applied within 12 hr. after manufacture and distributed with warm rakes.

Skid-tests with a skid-test car showed no lower coefficients of friction than the original asphaltic concrete carpets. For speeds of 60 and 80 km./hr. a higher coefficient of friction was sometimes found.

The costs of the treatment are 20 to 22 cts./sq. m., dependent on the price of rubber. N. J. C. T.

828. Improved Apparatus for Testing the Flexibility of Asphalt Coatings. H. Neumann. *Asph. u. Teer*, 1.3.39, **9**, 128.—An apparatus is described by which slabs of asphaltic material are tested at various temperatures for flexibility by bending over a hemispherical mandrel. The ends of the slab are held in such a way that they can close in naturally as the bending becomes more acute, without altering their lateral position. The rate of bending is controlled by the rate at which the mandrel is raised, and the reading is taken of the height to which the slab can be bent before cracking appears. Reproducibility is claimed to be good and the apparatus is said to be an improvement on those previously described. H. L. W.

829. Use of Asphalt Roads in France. M. Duriez. *Rev. Pétrolif.*, 1939, (828), 309.—A short summary is given of the production of various types of bitumen in France, followed by an account of the more important properties of bitumen, together with theoretical considerations of these properties.

In actual road construction and surfacing, bitumen alone is seldom used owing to the high temperatures necessary for its successful application and the rapid chilling which takes place on application making complete penetration difficult. Cutbacks are used to a large extent, and usually contain about 17% of fluxing agent, and bitumen emulsions of various types are also widely used. E. W. H.

830. Non-skid Properties of Road Surfaces. R. N. J. Saal. *Asph. u. Teer*, 1939, **39** (9), 138–140 and (10), 155–159.—The paper deals with the examination of road

surfaces using a special machine for determining the adhesion between a tyre and the road. The machine consists of a short-chassis motor truck fitted with an articulated platform at the rear, supported on a single wheel. This wheel, which is equipped with brakes and a speed indicator, is connected up to a dynamometer, and has provision for loads varying from 400 to 1000 kg. On the fore part of the truck is a water tank and pumping equipment, whereby water can be applied at varying rates on to the road in front of the trailing wheel. The tests depend on the fact that a tyre slides on the surface of the road when the horizontal force, measurable on a dynamometer, which the vehicle exerts on the wheel is greater than the frictional force between the tyre and the road, this latter force being the product of the normal force exerted on the road, and the coefficient of friction.

On perfectly dry roads the coefficient of friction is practically independent of velocity, and varies between 0·8 and 1·0. On wet roads, however, the coefficient is influenced by the speed, decreasing with increasing speed, except in the case of very rough surfaces. With damp, as distinct from thoroughly wet surfaces, this decrease in friction coefficient with increasing speed is even more marked.

A coefficient of friction of 0·4 is regarded as the limiting value between safe and unsafe roads, figures as low as 0·25 being regarded as dangerous.

Application of brakes was made in two ways during the tests: (*a*) in such a way that the wheel just did not slide, and (*b*) fully, so that sliding took place. It was found that the coefficient of friction showed a 20% higher value under (*a*) conditions than (*b*).

It was also found that when the viscosity of the liquid medium between tyre and road on a wet surface increased, as for example by the action of rain on dust, the coefficient of friction decreases.

Investigations were carried out on the effect of tyre-tread design, the influence of load on the trailing wheel, of tyre pressures, and of tyre use, *i.e.*, tread removal. Tests were also made with varying wet conditions, water being sprayed in front of the wheel at rates varying from 0·35 to 35 litres per minute, and these tests were repeated on road surfaces constructed of widely differing materials. E. W. H.

831. Properties of Binders and Adhesion to Mineral Aggregates. H. Suida, O. Jekel, and K. Haller. *Asph. u. Teer*, 1939, **39** (17), 253; (18), 267; (19), 283 and (20), 295.—The paper deals with an investigation of the effect of various factors on the resistance to displacement of bitumen coatings on aggregates when immersed in water or aqueous solutions, the immersion tests being made at 20° C. for 24 hr. and 40° C. for 3 hr. The materials used were various types of stone, road tars, a series of synthetic tars, and Mexican and Roumanian bitumens with and without the addition of various fillers, which included hard asphalt from bitumen and material insoluble in benzole from tars. The effect of the fillers on viscosity, penetration, softening point, and drop point was also determined. The authors do not agree with the views put forward by Mallison and Schmidt, and the following conclusions were reached from the results of the investigation. The properties of a binder are influenced by addition of filler only when the latter is capable of swelling in the binder. Hard asphalt or benzole-insoluble material from tar will disperse and give stable mixtures with bitumen or tar, the increase in viscosity and adhesion obtained being approximately proportional to the amounts added of material from a given source. The effect of the p_H of the aqueous medium is slight with binder-stone combinations having good adhesion, but the effect of varying p_H is marked with materials of poor adhesion. The adhesion either decreases with increasing p_H or reaches a minimum near the neutral point. The effect of solution of the stone in the aqueous phase is slight unless the p_H value of the latter is changed by this means. Bitumen and tar generally have similar adhesivity to a given stone, but stones differ in their behaviour with a given binder.
A. O.

832. Effect of Paraffin on Properties of Bitumen. V. T. Cerchez and V. Niculescu. *Monit. Pétr. roum.*, 1938, **39** (19), 1535.—This paper represents the first of a series of three on the effect of the addition of wax to bitumen. The effect on the physical properties is discussed here, whilst the two subsequent papers will deal with adhesion of waxy bitumens to aggregates, and the effect of wax on the properties of bituminous concrete respectively.

The first section of the paper gives an exhaustive review of the literature, and attention is directed to the work of Limbach, Hausmann, and J. Müller and Wandyez, who have worked with Boryslav bitumen. The review concludes with a summation of the various views put forward, and the conclusion is reached that the most recent work shows that, not only must the wax content be taken into account, but also the form in which it exists, *i.e.*, that the method of preparation may substantially modify the properties of the resulting bitumen.

The experimental work described is on the effect of wax on the physical properties of a series of bitumens of softening points 60–91° C. The waxes used were a paraffin wax melting point 52·5° C., a commercial ceresin melting point 85·5° C., and a casing wax, the latter containing about 10% of bituminous substances. The properties studied include the dropping points, softening points by Kraemer Sarnow, and ring-and-ball methods, ductility, penetration, stability, and temperature susceptibility.

The conclusions derived from the forgoing experimental work are summarized under three headings, according to the wax used as additant. The paraffin wax causes, in general, a lowering of the melting point, a diminution of ductility, and a variable influence on penetration. The action of heat (5 hr. at 163° C.) is also given.

The ceresin raises the softening point by both methods and causes a diminution of ductility. The casing wax, by reason of its bitumen content, exerts a slightly different effect from the pure ceresin. It has a variable effect on the softening point, causes a diminution of the ductility, and has a slight influence on the penetration. The results obtained are compared with those of Mannheimer (*Petr.*, 1932, No. 16). In conclusion it is suggested that the statement that a waxy bitumen is of low quality is not true, and the functions that influence the properties of the bitumen are not only the wax content, but also the form in which it exists. H. L. W.

833. Bituminous Protective Coatings. C. R. Platzmann. *Asph. u. Teer*, 1.3.39, **9**, 129–133.—The author suggests that with the large amount of bituminous coatings now being used, not all of it can be completely satisfactory, due either to the use of the incorrect grade of bitumen and/or solvent. Figures are given for the covering power of typical coatings on smooth and rough concrete, and on metal, by different methods of application. The possibility of a coating by hot application not being properly keyed in, especially with damp concrete, is enlarged upon, and this is given as the reason for adopting a priming coat of liquid, cold bituminous paint, followed, if necessary, by a hot application. For wet concrete a stable bitumen emulsion is suggested, as the quick breaking, road type is unsuitable. The disadvantage in regard to time and cost of hot application is analysed, comparing and contrasting with the cold coating, and the loss of solvent so incurred. It is suggested that a middle course between the hot application and the all cold coating is a priming or undercoat of cold paint followed by a covering of "floated" asphalt.

The second part of the paper deals with the formation of blisters on the bitumen, this being regarded as very important, leading to failure by the lifting of the coating due to seepage. For concrete it is stipulated that for fluid coatings it should be air dry, otherwise with changes of temperature blisters will occur. The stable emulsion, which can be used with concrete, flows into the pores before breaking. Another cause of blisters is the too quick application of one coat on top of another, not allowing the solvent to dry properly. A three-day drying period for each coat is suggested.

Some practical examples of failure due to insufficient precautions having been taken are given; one in which a concrete floor on which hard wood was cemented with bitumen failed, owing to water seepage causing the bitumen to lift from the concrete.

The type of bitumen to be used in paints for different purposes is then discussed, particularly in connection with the time of year at which they are to be used. It is suggested that by adjusting the bitumen-solvent ratio the viscosity of the coatings can be kept almost constant to suit climatic conditions. Blends of bitumen are suggested as being preferable to a single type, and, while tending to complicate manufacture, amply repay the extra trouble involved. While bituminous coatings, both in preparation and application, appear simple, such is not the case, and, as it is not sufficient these days for the protective surface to just look black, so the preparation of the paints has gone beyond the cookery book stage. H. L. W.

Special Products.

834. Film Continuity of Synthetic Resin Coatings. G. H. Young, G. W. Gerhardt, W. K. Schneider and G. W. Seagren. *Industr. Engng Chem.*, 1939, **31** (6), 719.—Studies in minimum coating weight of three methylacrylate polymers—namely methylmethacrylate, *n*-propylmethacrylate, and *n*-butylmethacrylate, all of which have a molecular weight exceeding 40,000—have been carried out. Employing an electrical method, the effect of composition and chain length on the minimum coating weights of these polymers was determined. It was demonstrated that the coating weight just required to produce continuity seems to vary inversely as the chain length of the polymers, and directly with the effective polarity. This relation has already been shown to be valid for vinylacetate and vinylchloride copolymers.
H. E. T.

835. Preparation of Pure *cyclo*Hexane. W. F. Seyer, M. M. Wright and R. C. Bell. *Industr. Engng Chem.*, 1939, **31** (6), 759.—Evidence is presented to show that methyl*cyclo*pentane is likely to be produced during the hydrogenation of pure benzene over a nickel catalyst. Thermodynamic considerations indicate that methyl*cyclo*pentane is more likely to be produced in the above reaction than *cyclo*hexane, thus the data given by Thomas, Egloff, and Morrell (*Industr. Engng Chem.*, 1937, **29**, 1260) show that the free energy changes for the two reactions involved are :

$$C_6H_6 + 3H_2 \rightarrow C_5H_{11}\cdot CH_3$$
$$\Delta F^0_{441} = -19{,}762$$

and for

$$C_6H_6 + 3H_2 \rightarrow C_6H_{12}$$
$$\Delta F^0_{441} = -4534$$

It is also possible that the method employed in preparing the nickel catalyst may influence the course of the hydrogenation reaction.

Pure *cyclo*hexane can, however, be produced from a reasonably pure commercial product by rectification in a Fenske, Quiggle, and Tongberg column. The physical constants of the pure *cyclo*hexane obtained were, density at 20° C., 0·7784; $\mu_{20°}$, 1·42635; freezing point, 6·47° C.
H. E. T.

836. Rust-proofing Greases. Anon. *Auto. Engr*, 1939, **29** (383), 133.—A description is given of various types of lanoline rust preventatives, together with the results obtained with them against the other types of temporary rust preventative. Typical tests of various commercial materials with mineral oil or spirit as carrier are given. Also actual tests of the commercial lanolines used are quoted. The method of application, use, and precautions for best results are enumerated. It is concluded that the increased protection obtained amply rewards the trouble taken in preparing the metal before coating.
H. L. W.

837. Methacrylate Resins. D. E. Strain, R. G. Kennelly and H. R. Dittmar. *Industr. Engng Chem.*, 1939, **31** (4), 382.—Polymeric methyl, ethyl, butyl, propyl, and *iso*-butyl esters of methylacrylic acid are water-white, thermoplastic resins with an established commercial value. Data on the physical properties, solubilities, and compatibilities with other resins and plasters of these polymeric methylacrylate resins are given.

Polymeric methyl methylacrylate is a hard, rigid resin with high tensile strength, which softens appreciably at temperatures exceeding 100° C. As the molecular weight of the esterified alcohol radicle increases, the polymers become softer and more plastic, whilst film forming, adhesiveness and solubility also suffer marked change as the molecular weight of the series increases.

Methylacrylate polymer is soluble in a variety of solvents, the higher esters becoming increasingly more miscible with aliphatic type solvents, the butyl and *iso*-butyl esters being soluble in petroleum solvents. The properties of the methylacrylate polymers, especially the higher esters, render them suitable for general industrial use as coating materials and as thermoplastic adhesives applied from solution. The films produced are fast-drying, water-white, tough, durable, and possess excellent electrical properties.

These polymeric methylacrylate resins have found application in a large number of commercial processes.
H. E. T.

838. Patents on Special Products. E. I. Du Pont de Nemours & Co. E.P. 502,680, 21.3.39. Appl. 21.9.37. Manufacture of boron fluoride from a mixture or compound containing boron fluoride and water, by reacting orthoboric acid with hydrogen fluoride and separating the boron fluoride from the resulting product by distillation under at least two different pressures.

G. W. Johnson. E.P. 502,961, 27.3.39. Appl. 27.7.37. Manufacture of hydrocarbons poor in H_2 by heating benzines richer in H_2 obtained by reduction of CO at 350–500° C. in the presence of catalysts, *e.g.*, mixtures of alumina and a smaller amount of a metal or compound of group 6 of the periodic system.

U.S. Industrial Alcohol Co. E.P. 503,052, 30.3.39. Appl. 16.5.38. Improved catalyst for the oxidation of olefines comprising a carrier of fused aluminium oxide or "Alundum" and aluminium silicate impregnated with catalytic silver and promoted by a compound of one of the metals of the alkali and alkaline-earth metal groups.

G. W. Johnson and I. G. Farbenindustrie A.-G. E.P. 503,220, 27.3.39. Appl. 26.8.37. Improvement in the manufacture of olefines and diolefines by the action of a halogen on saturated or unsaturated hydrocarbons in which the hydrogen halides are recovered. W. S. E. C.

Detonation and Engines.

839. Development of Fuels for Automobile Engines. Knock Rating Panel, Institute of Petroleum. *J. Inst. Petrol.*, 1939, **25**, 181–200.—The paper gives (i) an outline of the advances in gasoline quality made during the past decade, (ii) a description of the accepted knock-rating test, and (iii) summarized information obtained from road tests. G. R. N.

840. Engine Knock and its Effect on Fuel Development. D. M. Newitt. *J. Inst. Petrol.*, 1939, **25**, 137–148.—A paper presented at the South Wales branch which gives an account of the combustion of hydrocarbons in relation to their use in I.C. engines and with reference to the phenomenon of detonation. G. R. N.

841. Effect of Supercharging on Octane Rating. A. A. Dobrynin, E. I. Zabryansky, and N. S. Pronin. *Neft. Khoz.*, April–May 1939, **20** (4–5), 56–58.—Several typical gasolines and benzol blends with octane numbers between 75 and 105 have been investigated on a supercharged C.F.R. engine. Induction pressure was varied between 1 and 1·5 atm., maintaining compression ratio constant at 5·5.

Allowable boost ratios were estimated according to Boerlage, Peletier, and Tops (*Aircraft Engng*, 1935, p. 306).

It has been found that straight-run and cracked gasolines containing lead had similar octane numbers determined by the supercharging and conventional "Motor" method. Octane numbers of gasoline-benzol blends, however, differed greatly from "Motor" method ratings. L. R.

See also Abstract No. 811.

Coal and Shale.

842. Analysis of the Kerogen of Oil Shales. A. L. Down. *J. Inst. Petrol.*, 1939, **25**, 230–237.—Sample of five British oil shales were examined; after removal of 99% of the mineral matter by acid treatment the de-ashed samples were analysed and the compositions of the kerogens were calculated. G. R. N.

843. Origin of Sulphur in Seefeld Shale Oil. E. A. Wernicke. *BrennstChemie*, 1939, **20**, 123–125.—Seefeld shale oil contains about 13% sulphur, and similar contents are found in its product, ichthyol. Investigations have been carried out to ascertain whether the bitumen prepared from Seefeld shale contained organic sulphur compounds, or whether it consisted of hydrocarbons which reacted, in the course of retorting, with elementary sulphur or inorganic sulphur compounds under cyclization and formation of thiophen compounds.

It has been proved that the chloroform-soluble portion of the original bitumen contains organic sulphur compounds, and, further, that the total sulphur (14·3%) is organically combined. The sulphur content of the extract is equal to that of the retorted oil. This renders it very likely that the insoluble higher polymerized portion of the bitumen also contains similar sulphur compounds. L. R.

Economics and Statistics.

844. World Legislation concerning Petroleum. Y.P.F. Librarian. *Bol. Inform. Petroleras*, February 1939, **16** (174), 56–71, and March 1939, **16** (175), 78–86.—A useful reference list is being compiled giving titles of books, articles, and official publications, from all countries in the world, dealing with legislation affecting mineral oil in all its aspects. Each reference is followed by a few words indicating the contents of the publication. This bibliography will be continued in further issues. H. I. L.

845. The World's Petroleum Trade. Anon. *Przem. Naft.*, 25.2.39 (4), 99–101.—A comparison of recent statistical data, relating to trade with crude oil and its products, with analogous data from pre-war times shows not only the general increase in quantity of transported goods, but also a definite shift in the proportion of the transported crude oil to its refined or semi-refined products. The trade in crude oil to-day has outnumbered by far the trade of any of its products.

Before the war, refineries were mainly built in the vicinity of oil-fields. In time some plants were installed near more important ports, and later in some of the importing countries. In recent years the number of refining plants in countries poor in crude oil, where the refining process could only be carried on with financial help from the State, has increased considerably. Two reasons are given for this:

(1) The discovery of big oil deposits in countries with a low consumption capacity and small technical possibilities for refining large amounts of crude oil.
(2) The policy of some consumer states striving for development of a refining industry, independent of concrete possibilities or rational economy of supplying the refineries with the necessary amounts of crude oil.

This has been brought about by either particularly propitious conditions of crude oil import or by advantages obtained through producing only those final products which can successfully compete with those imported.

The above views are illustrated by numerous examples and tables showing oil production of different countries in relation to their exports of crude oil and its products.

Another table shows the shift from final products to crude oil in the imports of non-producing countries. E. J. W.

846. Production and Export of Petroleum from Peru in 1938. Anon. *Bol. Inform. Petroleras*, March 1939, **16** (175), 77.—This brief report in letter form gives total production of crude oil and export totals of crude oil and derivatives for 1938. Production amounted to nearly 2,100,000 metric tons. The editor of the *B.I.P.* points out that it is not possible to give the equivalent figure in barrels, because this would vary with the average specific gravity of Peruvian petroleum, which figure has not been stated in the report. H. I. L.

847. Report by the National Inspectorate of Petroleum of Colombia. S. G. Bernal. *Bol. Inform. Petroleras*, March 1939, **16** (175), 60–76.—In this detailed report it is shown that under the contract of August 1919 concluded with the Tropical Oil Co., and in accordance with Laws 37 of 1931, 80 of 1931, and 160 of 1936, royalties and taxes due to the Government may be paid in money or in kind. In the former case difficulties are met with in agreeing on the price, so that the best solution of the problem in the national interest would be establishment of a Government refinery or refineries, and assuming that for 1940 the royalties will be equivalent to 4 million barrels in round figures, the provision of tank farms at the ports will likewise be essential.

Full particulars are given, with numerous tables, of the activities of the different countries operating the wells, refining, and transporting (pipe-lines). Tables 15 and 16 show quantities exported to foreign countries and the average prices obtained.

H. I. L.

848. Production and Consumption of Petroleum in Hungary. I. K. Turyn. *Petrol. Z.*, 1939, **35**, 226–228.—The oil-fields of Lispe, where very good drilling successes were achieved in 1939, are controlled by a Hungaro-American company, the "Maort," and the production in 1939 was 20,000 tons of crude oil per month. At present nearly 13,000 tons are already extracted, and as the oil requirements of the country are only some 350,000 tons per year, it is hoped that the self-sufficiency of Hungary will be attained within two years as far as mineral oil products are concerned.

On the other hand, no cracking facilities are to be found in the country, the so-called refineries only being able to handle the semi-finished Roumanian products of different kinds, but a cracking plant of 20,000 tons yearly capacity is reported to have been ordered some weeks ago.

E. W. S.

BOOK REVIEWS.

The Technology of Solvents. By Dr. Otto Jordan. Translated by Alan D. Whitehead. Pp. 347. Technical Service Library, Leonard Hill, London. Price 25*s*.

The 1932 edition of Jordan's *Chemische Technologie der Lösungsmittel* is already well known as an indispensable handbook by the majority of oil and colour chemists, and, in addition, has proved to be a valuable book of reference to many technologists in other branches of the solvents industry.

Mr. Whitehead has made an excellent translation of the original, and by bringing the present English edition up to date by including much additional information concerning the more recently introduced solvents and plasticizers, has made a very useful contribution to the reference literature of the subject. Many developments in this field have taken place since the publication of the German edition, and the translator's task has been considerable in this respect, but by a careful selection of material he has made the book an indispensable aid not only to solvent technologists, but, in view of its comprehensive nature, to academic workers in general. In this latter respect it is of particular value, in that it gives a very complete list of many commercially available solvents, which, although in some instances they have been vended for a considerable time, have not entered into academic research to the degree they deserve.

A general account of the theories of solution mechanism is given in simple terms, and this leads on to the more detailed treatment of the physical properties of solvents, such as: boiling point, vapour pressure, rate of evaporation, solvent mixtures, inflammability, and refractive index. In view of the fact that the prime use of solvents is in the field of paints and varnishes, the subsequent treatment of physical aspects, such as solvent power, viscosity, etc., has a direct bearing on the problems of lacquer production, and here the author's expert knowledge has led to a very explicit exposition of the technicalities connected with the utilization of cellulose esters, synthetic polymerization products, rubber, and chlorinated rubber in finishes.

Although the treatment of the subject in itself is fairly comprehensive for the scope of the book, a welcome feature is the inclusion of well-chosen references. In this respect the book will be of value to newcomers to the field of lacquer technology, since it goes a long way in sorting the wheat from the chaff of a very extensive literature.

Plasticizers are dealt with chiefly in respect to their use in synthetic finishes, and here again the author shows his close connection with and appreciation of the current problems of this branch of technology.

The chapter dealing with the physiological action of solvents, although of a summary nature, is of value in itself, but, in addition, gives reference to the rapidly expanding medical literature on the subject. A detailed treatment would have been outside the scope of the book, but the author has succeeded in stressing the chief health hazards and the protective measures which have led to a considerable reduction in the incidence of industrial diseases caused by solvents.

This comparatively complete treatment of the technology of solvents also includes brief descriptions of the methods employed in: the analysis of solvents, the recovery by absorption and condensation, the chemistry of the production of the chief solvents from raw materials. This latter account would form a very useful addition to most text-books of organic chemistry.

A considerable portion of the book is devoted to the cataloguing of the chief industrial solvents, together with detailed information of their physical properties, and as the book is well indexed, it forms a ready source of everyday information. These main points, and the fact that it is up to date, recommend it as indispensable to all solvent technologists and organic chemists. D. J. BRANSCOMBE.

Solvents. By Thos. H. Durrans, D.Sc. (Lond.), F.I.C. Pp. 238. D. Van Nostrand Company, Inc., New York. Price 15*s*.

A book which has passed successfully through three editions and has now entered into its fourth needs no recommendation from a reviewer, especially when it is

one of the first in the field of its kind to be written by an author fully conversant with his subject. Since the publication of the third edition there has been considerable activity in the technology of synthetic finishes in so far as solvents and plasticizers are concerned, and thus the amount of new material incorporated in the latest edition presents an up-to-date handbook which should be on the bookshelf of every technologist engaged in the chemical finish industry.

The main feature of the book is the catalogue of the solvents which are industrially available, as this presents information concerning their characteristics in a very accessible form, and this is all the more valuable in that an attempt has been made to equate chemical individuals with trade names.

The title is rather inapt, as it gives the impression that solvents are dealt with in a broad sense, but actually the author treats them chiefly from the angle of their application in chemical finishes. There is, however, a condensed exposition of the scientific fundamentals of the process solution couched in simple terms with the avoidance of mathematics, and the author has succeeded in expounding such subjects as solvent action, solvent power, plasticizing, solvent balance, viscosity, evaporation, and inflammability with such clarity and simplicity that the book, in addition to being of use to the technician, should also appeal to the inquiring layman. A comprehensive treatment has not been aimed at, but the well-chosen references to the original literature make the book a very suitable stepping-off ground for those wishing to take a deeper interest in the technology of chemical finishes.

In addition, the book can be recommended to organic chemists in general, as it should be of definite assistance in helping in the everyday task of seeking the appropriate solvents for crystallization. D. J. BRANSCOMBE.

On the Edeleanu Process. By J. C. L. Defize. Pp. 310. Published by D. B. Centen's Uitgevers-Mij. N.V. Amsterdam, 1938.

This is a book of considerable importance, as although there is no dearth of literature to-day dealing with solvents and solvent processes—and indeed there are more than 133 references in the bibliography contained in this book to literature dealing with this particular process—nevertheless there is no other single book which deals so thoroughly and so competently with all aspects of this very useful process.

The book is an expansion of a thesis presented for D.Sc., Strasbourg, and should satisfy the most exacting theorist in its treatment of phase-theory applied to mixtures of SO_2 and oils. Nevertheless, the not-so-academic plant-chemist will be equally grateful for discussion of what he will consider the more practical, but still to some extent theoretical questions, such as the limitations of the process, the reasons for introducing benzole, the bearing of aromatic content on the burning properties of kerosines, etc., in a manner which bears witness to the author's experience as a plant chemist. There is, in addition, a wealth of information for the engineers on lay-out, methods of evaporation and drying, metallurgy and other information indicating the patience and tenacity brought to bear on the problem, which have made possible the plant of to-day.

Dr. Defize, the author, would be the first to admit—as indeed he does—that there will continue to be problems for some time to come, but the reviewer has had sufficient experience spread over seventeen years to concur heartily in the claim made that the Edeleanu Process has evolved from a troublesome plant to a dependable, continuous, and economic production unit as a result of a fine piece of work in the domain of applied engineering.

The book has four main sections—Introduction, a process section, a theoretical section, and an experimental section—but the " separation " achieved in the book, as in the process, is not by any means complete, some degree of practical overlap being found in all the sections.

(1) INTRODUCTION.—In the introduction, descriptions, including flow sheets of SO_2 plants for light oils, are given in detail, and although the most modern units using SO_2 and benzole for the treatment of lubricating oil are not illustrated, sufficient is given to present a very good picture of the general design and operation of the Edeleanu Process.

(2) PROCESS SECTION.—In this section an excellent explanation is given of why the process works at all. The fact that oils usually dealt with have two classes of component—one of which (called for the purpose of this process "aromatics") is miscible in all proportions with SO_2, and the other class (called simply "non-aromatics") has a limited miscibility—renders possible the use of this and other solvent processes for the refining of oils.

When SO_2 is mixed with the oil under such conditions that two layers are formed, one layer consists mainly of SO_2 and the other layer mainly of the non-aromatic portion; the SO_2 layer holds most of the aromatic portion, but leaves some amount of aromatics and SO_2 in the non-aromatic layer. Separation of these two layers and freeing them from SO_2 gives a complete recovery of the original oil as two oils of different character, *i.e.*, A and NA. These are generally referred to as extract and raffinate, respectively. The degree to which the two products approximate to "pure" extract and "pure" raffinate (within the arbitrary definition) is settled by the conditions of operation, *e.g.*, the temperature, the proportion of SO_2 to oil, the degree of counter-currency, etc., thus giving the process great flexibility.

Considerations of design and operation are discussed in a manner which testifies to the experience and ability of the author.

(3) THEORETICAL SECTION.—The now well-known and much-used application of triangular graph representation of three-component systems to the very complicated multi-component oil–SO_2 equilibria are very well dealt with indeed. The predictions of theory are contrasted with actual findings, and considerations of economy which limit the desirable completeness of separation even within theoretical possible limits are discussed with great insight.

This part of the book could not, by its nature, be very easy reading, but any knitting of brows required to follow the arguments is well repaid by the very clear picture that emerges of the scientific and technical background to the process.

(4) EXPERIMENTAL SECTION.—If the Edeleanu Process can be considered for simplicity to have two main constituents, "T" and "P" (theory and practice), which are to be separated by the double solvent "P" and "C" (professor and chemical engineer), it has to be admitted that this particular product, Part IV, is the result of very incomplete separation. This is, however, no real drawback, and the result is a very useful mixture of experimental findings and continued theoretical discussion. A very complete account is given of investigations, in particular of a kerosine distillate from Borneo crude, illustrating in detail the tests carried out, the triangular graphs constructed, and the conclusions to be drawn. The idea of introducing controlled aromatics in the form of benzole as an auxiliary solvent is discussed and explained. Lubricating oils are thoroughly dealt with, and it is shown that the simplification achieved by a theoretical treatment, assuming two oil constituents only—*i.e.*, aromatics and non-aromatics—whilst good enough for most purposes, gives discrepancies which indicate quite clearly that at least three oil components, *e.g.*, aromatics, naphthenes, and paraffins, should really be considered. Petrol refining is also dealt with, and it is shown that separation of naphthenes and aliphatics by SO_2 is very difficult, although segregation of aromatics is quite a practical proposition.

Of all the experimental work dealt with in connection with kerosine, lubricating oil, and petrol, it can be said that kerosine refining is most completely established, lubricating oil moderately well, and petrol rather in its infancy.

The book is rounded off with a miscellaneous chapter which deals in a competent way with practical matters such as the de-aerating of SO_2, the removal of the last traces of SO_2, and the economy of modern methods of evaporation.

The whole constitutes a book that will repay study by every keen technologist, whether directly interested in designing and operating Edeleanu plants or not. It is, in fact, a very excellent and varied "mixed grill," and if little bits of fare are too tough for some teeth, well, there is enough on the plate to supply quite a good meal, even if some of the less digestible bits have been left on one side.

E. THORNTON.

De La Carbonization aux Carburants D'Aviation. Tome I. Le pétrole et ses succédanés. By Charles Berthelot. Preface by G. Claude. Pp. 327, with 73 figures in text. Published by Dunod, 92, Rue Bonaparte, Paris, 1939. Price 107 frs.; Paper cover, 90 frs..

This work is a continuation of the series of informative books by the same author, published by Dunod, on synthetic and substitute motor fuels. That this subject is of great public interest at the present time is evident by the fact that the author has been requested to write two more volumes in the same series. One of these will be devoted entirely to modern coke-ovens and gas works, including the recovery of by-products and gas distribution, whilst the other volume will deal with the utilization of coke-oven gases as sources of synthetic chemical products, such as motor spirit, alcohols, etc.

In the volume under review, the author begins with a *résumé* of the three published reports by Sir David Rivett, Lord Falmouth, and the Labour Party. In each case the conclusions arrived at are clearly stated.

The national policy in regard to petrol and substitute fuels of Great Britain, France, Belgium, Germany, and Italy is outlined. The estimated annual requirements of these different countries are given, together with the various measures under consideration for meeting those requirements.

The author describes in detail the principal processes in use in different countries for the carbonization of coal, lignite, bituminous shales, wood, and oil-yielding seeds. He brings into focus the vast amount of information which he has obtained, for the most part personally, from numerous countries. A tribute is paid to the valuable papers presented to the recent Congresses held in Rome and in Glasgow, and to various French and foreign technical publications. The Institute of Petroleum is congratulated on the success of the first International Congress on Bituminous Shale and Cannel Coal, which it organized in Glasgow last year. A number of concrete examples of industrial achievements are described in the book, which enable the reader to appreciate the progress which has been made.

A section deals with the use of producer gas obtained from various carbonaceous materials as a motor fuel, and also with the utilization of compressed gas for the same purpose. Comparative costs are given and, in the case of cylinders for compressed gas, the chemical and physical characteristics of the special steels used are described. In discussing safety factors, an account is included of the bursting tests made by Monsieur Pignot, of the Paris Gas Company, to prove that there can be no objection on the grounds of safety to the use of bottled gas under pressures of 200 atmospheres, or even up to 400 atmospheres.

The final section of the book gives the general conclusions arrived at by the author.

M. Berthelot writes of the risks incurred during the last War of transporting fuel supplies by sea. He stresses the necessity, in time of peace, for countries to instal plant and machinery for obtaining substitute motor fuels, because all petrol supplies will be reserved for military purposes in the event of war. In the face of such grave dangers, he advocates that France and her Empire should make the maximum use of their immense reserves of timber, oil-yielding seeds, bituminous shale, etc.

The more general use of gas would assist the Gas Industry, and help to compensate for its losses due to the competition of electricity.

He points out how the Petroleum Industry has wisely recognized the importance of oil derived from shale, and refers to the very real progress that has been made in the Shale Industry as a result of co-operation with the Petroleum Industry. He advocates that all methods of obtaining liquid fuels should be co-ordinated, in order to supply the modern world with her requirements. He predicts new achievements as a result of further research.

In the opinion of the author nothing is more important at the present time than the manufacture of high-octane-number aviation fuels in France for use in bombing aeroplanes, and a reference is made to various processes which he claims to have made this possible. As the question of the technical processes to be used in the manufacture of aviation gasoline in France is still under discussion, M. Berthelot has not attempted to express any opinion as to the relative merits of the different processes which he mentions.

As in the case of the previous books written by M. Berthelot, the book under review is well printed and easy to read. It should be of great interest to economists and technologists engaged in the Mining, Metallurgical, Gas and Petroleum Industries, and it will also be useful to many others interested in substitute fuels.

W. H. CADMAN.

Tar Roads. By A. C. Hughes, W. G. Adam and F. J. E. China. Pp. 196. The Roadmakers' Library. E. Arnold & Co., London. Price 18*s*.

This book constitutes a very welcome and useful addition to The Roadmakers' Library. The subject is dealt with in a comprehensive manner by admitted experts, and the book will be accepted as an authoritative text-book as well as a book of reference.

Part I gives a brief historical introduction.

Part II deals with tar roads in great detail, and embodies the results of most of the recent researches on the subject. The formation of tar, its physical structure, and its constitution are all dealt with in a very informative way. This section of the book also deals with refining, blending, tar compounds, and tar emulsions.

The application of road tars is dealt with in Parts III and IV, which give a very thorough survey of modern methods, plant, and specifications.

The laboratory testing of the materials concerned is treated rather briefly in Part V.

A very useful collection of foreign specifications is given as an appendix, and the book is rounded off with a good bibliography.

J. S. JACKSON.

BOOKS AND PUBLICATIONS RECEIVED.

Methods for the Detection of Toxic Gases in Industry. Leaflet No. 3. **Sulphur Dioxide.** Department of Scientific and Industrial Research, H.M. Stationery Office, 1939. Price 2*s*. 6*d*.

The standard method developed for the detection of this gas depends on drawing a sample of the atmosphere by a hand-pump through test-paper treated with starch and potassium iodate to which potassium iodide has been added. The concentration is determined by comparing the stains produced with a standard colour-chart supplied with the leaflet. Concentrations down to 1 part in 250,000 can be estimated by making not more than ten strokes with the hand-pump. Complete instructions for carrying out the test are given.

Methods for the Detection of Toxic Gases in Industry. Leaflet No. 4. **Benzene.** Department of Scientific and Industrial Research, H.M. Stationery Office, 1939. Price 3*d*.

The chemical test recommended in this leaflet is capable of detecting concentrations down to 1 part in 10,000. The test involves the absorption of benzene vapour in concentrated sulphuric acid containing a trace of formaldehyde. An orange-brown colour is produced, with even traces of benzene. The test is carried out by drawing, by means of a hand-pump of definite capacity, a sample of the atmosphere under test through a tube containing the reagent and determining the number of strokes required to produce a certain standard depth of colour. From the number of strokes of the pump required to produce the standard colour, the concentration of benzene vapour present is obtained by reference to a table.

Methods for the Detection of Toxic Gases in Industry. Leaflet No. 5. **Nitrous Fumes.** Department of Scientific and Industrial Research, H.M. Stationery Office, 1939. Price 3*d*.

The Griess–Ilosvay test has been adopted as the standard test for nitrous fumes. It consists in drawing the atmosphere under test, by means of a hand pump, through a tube containing a mixed solution of α-naphthylamine and sulphanilic acid in acetic acid, until a certain standard depth of colour is reached. From the number of strokes of the pump required to produce the standard colour, the concentration of nitrous fumes present is obtained by reference to a table.

Transactions of the Institution of Chemical Engineers. Volume 16, 1938, pp. 250. Institution of Chemical Engineers, 56, Victoria Street, Westminster, S.W.1.

Of the fifteen papers presented during the year, the following are of particular interest: "Fundamental Principles of Industrial Filtration," by P. C. Carman; "The Principles of Design of Modern Industrial Furnaces," by C. Webb; and "The Sedimentation of Thick Clay Suspensions," by M. B. Donald.

Accidents in the Petroleum Industry of Oklahoma for 1937 summarized and compared with 1923. By C. F. McCarroll, pp. 19. U.S. Bureau of Mines. Report of Investigations No. 3446. May 1939.

The severity of the accidents during 1937 caused an increase in the number of days lost per accident and also in the average cost of compensation. The number of compensable accidents which occurred during 1937 were fewer than in 1923, the greatest decrease being in the refining and natural gasoline division, where the time lost per accident was also less.

Oil and Petroleum Year Book, compiled by Walter E. Skinner, 15, Dowgate Hill, Cannon Street, London, E.C.4. Pp. lxxvi + 416. Price 10*s*.

This is the thirtieth year of issue of this well-known directory of the petroleum industry. In addition to the references to 850 companies which constitutes the main portion of the book, it contains an alphabetical directory of company directors, secretaries, and consulting engineers; a glossary of petroleum terms and a short article on oil-company finance during 1938. Two regular features of the directory have been brought up to date and considerably extended—viz., the list of trade names of petroleum products and the directory of manufacturers supplying equipment. The former is a remarkable achievement, covering as it does about 800 proprietary names in Europe and America.

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Geophysics.

849. Care and Maintenance of Seismic Exploration Instruments. E. C. Stuedle. *Oil Wkly*, 29.5.39, **93** (12), 23.—Instrument up-keep embraces: (*a*) normal care which is or should be given to instruments by the field personnel in their daily work; (*b*) additional care which may be supplied by specially trained personnel detailed for this purpose; (*c*) methods by which obsolescence and run-down condition of instruments may be minimized; (*d*) factors of design which affect maintenance; (*e*) general benefits derivable from a systematic maintenance programme.

Field conditions profoundly affect the problem. Foremost amongst routine care duties come cleanliness and lubrication. The spring adjustment of seismometers is important with regard to record character, and attention must be paid to damping. Good light-sources and clean mirrors help towards good photographic records.

The various items of electrical equipment in the truck require a certain amount of looking after. In cold weather moisture is apt to condense on the metal parts and cause trouble. These effects can be minimized by keeping the interior of the truck warm at night. The complete equipment may include fifty or sixty vacuum tube circuits, and thus a multi-purpose meter is desirable, which may be used as an ohmmeter of various ranges, as a D.C.–A.C. voltmeter and milliammeter, and as a condenser-tester. A tube-tester is also of some value. Facilities should be provided for testing the geophone cables, and all temporary splices or repairs made in the field should be placed in good order before the next day of field work.

Three diagrams show the development of seismic instruments during the past few years.

A systematic programme of inspection and maintenance is essential. An instrument inspector should be in general charge of the instrumental equipment of the company. His duties are outlined. Instrumental design and the layout of equipment should have regard to field conditions. G. D. H.

850. Preliminary Micromagnetic Survey of the Eola Structure. W. P. Jenny. *Oil Wkly*, 29.5.39, **93** (12), 34–35.—The structural interpretation shown on an accompanying map takes into consideration a regional increase in the magnetic intensity which is due to down-dip thickening of the magnetic Wilcox section. The interpretation has been substantiated by drilling.

In the Gulf Coast area it appears that the Lower Miocene acts as the main magnetic stratum. In South-west Texas the magnetic method is credited with the discovery of a number of oil-fields, and ranks among the generally accepted geological tools.

It is probable that in the near future accurate regional magnetic surveys will be accepted as a highly effective reconnaissance method under almost any geological conditions, and that a detailed micromagnetic map of a prospect will be considered one of the essentials before locations are made for wildcats as well as extensions to proved fields. G. D. H.

851. Geothermal Gradients in Californian Wells. R. W. French. *Oil Gas J.*, 27.4.39, **37** (50), 43.—Oil-well temperatures based on true geothermal gradients are important

for reservoir content studies. Geological correlation is possible at times, and subterranean water movements have been detected thereby. The transient temperatures in wells affect mud performance and stability, and also the chemical treatment of wells; they indicate the progress of cementation and the position of cement, and are significant with regard to the thermodynamic analysis of flow-tube design and the use of phase-equibria tables.

Maximum registering mercury thermometers and resistance thermometers are commonly used, the latter being the more accurate and satisfactory. Other types are employed. Curves are given which show the distortion effects on the thermal gradient due to mud circulation and production, and which permit the location of cement. Tables give the approximate depth of the 175° F. isogeotherm in the Californian fields, and the temperatures at the bottoms of deep wells in some Californian fields.

G. D. H.

852. Structures in Sparta–Wilcox Trend Disclosed by Magnetics. W. M. Barret. *Oil Wkly*, 15.5.39, **93** (10), 42–43.—Recent results show that the magnetometric method may be well suited for disclosing anticlinal structures in the Sparta–Wilcox trend. The method is capable of covering large areas rapidly at a comparatively low cost. In this area, because of the feeble magnetic properties of the surface materials, deeper magnetic effects are not masked, whilst the basement rocks are so deep that their magnetic effects do not interfere with the anomalies traceable to folding in the sedimentary section. The Wilcox is the shallowest lithological unit in the trend which carries appreciable quantities of magnetic material. Because of its great thickness and properties, the principal magnetic anomalies of local areal extent are probably due to folding of the Wilcox.

In the Cheneyville and Eola fields the present oil-producing areas are embraced by closed contours which represent magnetic "highs" or maxima.

Experience shows that anomalous horizontal-intensity measurements, in addition to vertical-intensity data, are needed in determining the pattern of the structure.

The Sparta–Wilcox trend may cover 25,000,000 acres, of which only a tiny fraction will enclose Wilcox structures of economic importance. 10,000 acres/day can be covered with 1½ ml. spaced magnetometer stations, which are considered sufficient for locating pronounced Wilcox structures. This will cost less than 2 cents/acre.

G. D. H.

853. Geological Mapping from the Air. L. Desjardins and S. G. Hower. *Oil Gas J.*, 11.5.39, **37** (52), 44.—The tracing of outcropping beds is now being done stereoscopically with far greater facility than the equivalent task can be accomplished in the field by the usual plane table procedure. Individual beds present in the stereoscopic model definite characteristics by which they may be recognized and traced. The commonest criterion is the change in slope which they produce. Scarps which in the field are vague, or because of perspective lose their identity to an observer, are traced easily with the aid of a stereoscope. The vertical interval between beds is also characteristic, and helpful in obscure patches. Correlation is facilitated. With colour photography it may be possible to add such criteria as soil and vegetational colours. The location and type of vegetation are significant.

Highly accurate topographical maps can be produced from aerial photographs by mechanical means. Many of the instruments for this purpose are expensive and cumbersome, but the authors have developed a technique which requires only a Zeiss Pocket stereoscope. Allowance must be made for tilt, and with practice, this can be done without instrumental aid with sufficient accuracy for most geological purposes.

From the geological outcrops and the topographical contours, the structural contours can be constructed.

G. D. H.

Drilling.

854. Thixotropy and its Industrial Applications. H. Freundlich. *Chem. & Ind.*, 1939, **58**, 469–470.—In some cases (sols of oxides) thixotropy may be considered as the first stages of coagulation, in other cases (*e.g.*, bentonite suspensions) thixotropy is closely related to the hydration of the particles.

An interesting application of thixotropy is in petroleum drilling mud. Some drilling muds cause trouble by settling to a hard cake, a thixotropic mud forms a soft gel which is readily re-liquefied.

Paints, printing inks, and certain honeys afford industrial examples of thixotropy. T. C. G. T.

855. Drilling Patents. J. J. Jakosky. U.S.P. 2,150,169, 14.3.39. Appl. 9.3.37. A method for determining variations in an electrical property of the strata at different depths.

F. J. Hinderliter. U.S.P. 2,150,221, 14.3.39. Appl. 15.7.35. Rotary tool joint.

R. C. Baker. U.S.P. 2,150,311, 14.3.39. Appl. 12.12.38. Wash-down and cementing shoe for well casings.

G. Tremolada. U.S.P. 2,150,529, 14.3.39. Appl. 14.7.37. Rotary swivel.

R. A. Mueller and R. Smith. U.S.P. 2,150,887, 14.3.39. Appl. 13.1.36. Method and apparatus for completing high-pressure wells.

J. Suth. U.S.P. 2,151,057, 21.3.39. Appl. 7.10.36. Hydraulic lift for the boom of a portable well drilling rig.

R. P. Fisher. U.S.P. 2,151,347 and 2,151,348, 21.3.39. Appl. 14.2.38 and 13.4.38. Rotary drilling bit.

J. A. Zublin. U.S.P. 2,151,544, 21.3.39. Appl. 21.3.39. Composite bit for wells.

P. Subkow and L. Dillon. U.S.P. 2,151,646, 21.3.39. Appl. 28.6.38. A drilling mechanism enabling the bit to be rotated at a speed greater than that of the stem and a clutch to enable the bit to be locked and so rotate at the same speed as the drill stem.

C. A. Baker. U.S.P. 2,152,341, 28.3.39. Appl. 25.4.36. Core catcher. L. V. W. C.

Production.

856. Production Patents. N.V. de Bataafsche Petroleum Mij. E.P. 506,904, 6.6.39. Appl. 29.12.38. Process of sealing and/or solidifying water bearing strata by causing a solution of asphalt bitumen in an organic solvent or mixtures of solvents which are completely miscible with the water at the temperature of the strata to be treated, to penetrate into the strata. W. S. E. C.

L. F. Lamb. U.S.P. 2,150,228, 14.3.39. Appl. 31.8.36. Well packer.

R. C. Baker. U.S.P. 2,150,310, 14.3.39. Appl. 12.13.38. Protective housing for deep well packers.

C. C. Taylor. U.S.P. 2,150,406, 14.3.39. Appl. 22.4.36. Well cleaner, consisting of two swabs encircling a tubing string and means to move the swabs in opposite directions with respect to the casing by movement of the tubing.

J. P. Black. U.S.P. 2,151,416, 21.3.39. Appl. 3.5.38. Perforation cleaner having a number of wire bristles around the periphery.

J. A. Emerson. U.S.P. 2,151,588, 21.3.39. Appl. 28.6.37. Deep-well pump.

O. A. Brown. U.S.P. 2,151,681, 28.3.39. Appl. 5.6.34. Casing perforator of the mechanical type.

H. C. Yarbrough. U.S.P. 2,152,008, 28.3.39. Appl. 24.11.32. Mechanical casing perforator.

B. P. Wininger. U.S.P. 2,152,298, 28.3.39. Appl. 24.8.38. Connector for bailers and sand pumps. L. V. W. C.

Crude Petroleum.

857. Hydrogen Sulphide in Ishimbaevo Crude. V. G. Plusnin, E. A. Nikonova and S. S. Spasski. *Neft. Khoz.*, February 1939, **20** (2), 46–49.—It has been found that Ishimbaevo and Krasnokamsk (upper horizon) crudes contain dissolved hydrogen sulphide. Other sulphur crudes, however—for instance Chussov, Samarskaya Luka and Krasnokamsk (lower horizon) crude—do not contain hydrogen sulphide.

In the first four of the above-mentioned crudes formation of pyrogenetic hydrogen sulphide starts at temperatures in the neighbourhood of 200° C., and only with Krasnokamsk (lower horizon) crude at about 300° C.

Ishimbaevo crude, during non-destructive distillation, liberates great quantities (up to 7 kg. per 1 ton crude) of pyrogenetic hydrogen sulphide. At 300° C., hydrogen sulphide formation is almost finished within 1 hr. At 350° C., pyrogenetic hydrogen sulphide is formed from elementary sulphur and sulphur compounds of the disulphide type.

Up to 68% of the pyrogenetic hydrogen sulphide liberated at low temperatures from Ishimbaevo crude is formed from sulphur compounds contained in the asphalt-bituminous fractions, and only 32% from those of the kerosine-lubricating oil fractions.

L. R.

858. Examination of Kusyapkulov Crude. E. A. Kazmina. *Neft. Khoz.*, April–May, 1939, **20** (4–5), 58–60.—The Kusyapkulov field is situated in the Bashkir Republic of the U.S.S.R. on the right bank of the Byelaya river, not far from Sterlitamak.

Kusyapkulov crude differs from other crudes of the Sterlitamak rayon by its higher specific gravity, viscosity, and Conradson coke, and also by its considerably higher contents of asphaltenes, resinous substances, and sulphur.

Distillation of the crude resulted in: 16% gasoline–ligroine fractions (I.B.P. 200° C.), 22% kerosine fractions (200–300° C.), 31% gas-oil and lubricating-oil fractions, and 31% bitumen residue.

The gasoline, ligroine, and kerosine fractions have high sulphur contents. The lubricating-oil fractions have a relatively high specific gravity, a high pour point, and high sulphur contents. The residual oil is a high-quality road bitumen (Russ. Standard No. III).

L. R.

859. Patent on Crude Oil. C. M. Blair, Jr. U.S.P. 2,159,312 and U.S.P. 2,159,313, 23.5.39. Appl. 13.12.37. Breaking naturally occurring oil-in-water emulsions from crude petroleum using as emulsifier glue and calcium chloride. W. S. E. C.

Gas.

860. Dangerous Gases in Distillation and Refining Processes. E. Le Q. Herbert. *J. Inst. Petrol.*, 1939, **25**, 323–346.—A paper, with twenty-nine references, which discusses the effects of the various gases and solvent vapours that may be encountered in a petroleum refinery and the precautionary means that are adopted. G. R. N.

861. Protection against Dangerous Gases in the Operation of Cracking Units. E. J. M. Tait. *J. Inst. Petrol.*, 1939, **25**, 347–355.—Gas produced in the cracking operation is discussed under the items, gas-masks, drawing samples, pump-houses, trenches, sumps, etc., pressure relief, drop out and drain lines, clean outs and repairs, furnaces corrosion, and safety instructions. G. R. N.

862. Detection of Gas in Field and Refinery in Iran. Anglo-Iranian Oil Co. *J. Inst. Petrol.*, 1939, **25**, 356–358.—The methods employed for the detection of hydrogen sulphide and sulphur dioxide by the Anglo-Iranian Oil Co. are described.

G. R. N.

863. Safety of Electrical Apparatus for Use in Inflammable Gases and Vapours. C. B., Platt. *J. Inst. Petrol.*, 1939, **25**, 368–376.—A report, which deals with design of bells, telephones, and lamps, which are intrinsically safe for use in atmospheres containing

petroleum vapours. The difference between intrinsically safe electric apparatus and flame-proof enclosures is indicated. G. R. N.

864. Flame Arrestors. H. H. Radier. *J. Inst. Petrol.*, 1939, **25**, 377–381.—The "gravel box" type of flame arrestor is described. G. R. N.

865. Physiological Effects of Toxic Gases and Vapours. T. McClurkin. *J. Inst. Petrol.*, 1939, **25**, 382–391.—A paper in two parts, the first dealing with those gases and vapours likely to be encountered in the petroleum industry, and the second with a group of other toxic gases and vapours. G. R. N.

866. Detection of Toxic Gases in Industry. R. B. Vallender. *J. Inst. Petrol.*, 1939, **25**, 392–409.—A comprehensive paper on industrial gases with particular reference to their effects on the health of the worker and to the methods that can be employed for their detection. G. R. N.

867. Detection of Toxic Gases and Vapours in Industry. R. B. Vallender. *Chem. and Ind.*, 1939, **58**, 330–333.—The sense of smell and the behaviour of animals are both unreliable as general methods for detecting the presence of traces of toxic gases in industrial atmospheres. The need for simple, rapid, semi-quantitative tests, sensitive to very low concentrations of gases and vapours, is pointed out, and the suitability of existing methods of gas determination discussed.

A series of colorimetric tests have been developed, and those for detecting hydrogen sulphide, hydrogen cyanide, arsine, sulphur dioxide, phosgene, nitrous fumes, chlorine, carbon disulphide, aniline, benzine, carbon monoxide, and chlorinated hydrocarbons are described. Lead acetate paper is used for H_2S, H_2SO_4 containing formalin for C_6H_6, iodine pentoxide or palladium chloride for CO, whilst the halide lamp, which produces a green flame in the presence of halide, is used for chlorinated hydrocarbons. Pamphlets describing the tests are to be issued by H.M. Stationery Office on behalf of the D.S.I.R. T. C. G. T.

868. Handling of Petroleum Spirit and Solvents. F. N. Harrap. *J. Inst. Petrol.*, 1939, **25**, 359–367.—A summarized account of the various precautions taken by the petroleum industry and its customers against the various risks attached to the handling of toxic gases. G. R. N.

869. Vertical Retorts with Continuous Water Gas Production. A. Thau. *Oel u. Kohle*, 1939, **15**, 419–425.—By far the most widespread type of gas-producing oven is the vertical retort; a table is given showing the increasing production from Dessauer vertical retorts from their introduction in 1906 to an output of 16 million cubic metres daily in 1938 (in Germany). More recent developments include independent continuous water-gas producers which can be connected in series with coke-ovens to give gas of the desired calorific value. An outline is given of recent developments in production that have been made by the leading German gas concerns.

T. T. D.

870. Thylox Process for the Recovery of Sulphur from Gases containing Hydrogen Sulphide. G. E. Foxwell and A. Grounds. *Chem. & Ind.*, 1939, **58**, 163–170.—The Thylox process is reviewed. The process may be operated to remove 100% of the H_2S in industrial gases, but the authors consider that the most economical procedure is to remove 98% of the sulphide by the Thylox process and the remaining 2% by use of oxide catch-boxes.

The Thylox process depends on the absorption of H_2S by ammonium thioarsenate solution, and the regeneration of the higher thioarsenate, so formed, by oxidation with the liberation of sulphur. The process may be represented :—

$$\text{Absorption : } (NH_4)_3AsO_2S_2 + H_2S = (NH_4)_3AsOS_3 + H_2O$$
$$\text{Regeneration : } (NH_4)_3AsOS_3 + \tfrac{1}{2}O_2 = (NH_4)_3AsO_2S_2 + S.$$

The process is finding favour even in countries like Japan and America, which have natural supplies of sulphur.

Among the examples quoted of plant operating is one which removes 99·99% of the H_2S from a gas containing 410 grains of H_2S per 100 cu. ft., and representing an absorption of 4½ tons of H_2S per day.

The Thylox process also removes HCN.

The economies of the process and the uses of the sulphur produced are outlined.

T. C. G. T.

871. Gassing Accidents. S. H. Wilkes and D. Matheson. *Chem. & Ind.*, 1939, **58**, 316–323.—The authors, as H.M. Engineering Inspectors of Factories, receive reports on all factory accidents, and in many cases take a direct part in the subsequent investigations. In this paper they indicate how and where gassing accidents have occurred during recent years, and the steps taken to prevent them. The medical aspect and the apparatus both for breathing and for testing poisoned atmospheres are not discussed.

Gassing accidents over the period 1932–37 are tabulated. In 1937, of 196 reported accidents, 92 were due to carbon monoxide, and of these 37 were connected with blast-furnaces. Of other toxic gases, chlorine accounted for 19 cases, trichlorethylene 7, benzol 4, petrol and benzine 1, and bitumen, creosote, oil, and tar for 1.

A warning is stressed to those recovering solvents by distillation. The distillate should not be received in a workroom, and, to ensure adequate cooling from the start of the distillation, the control for starting the heat should be locked to the condensing water-control valve.

T. C. G. T.

872. Patents on Gas. G. Budan. E.P. 504,579, 27.4.39. Appl. 10.1.38. Device for determining the contents of poisonous gases in air, *e.g.*, war gases, which are not physically perceptible.

T. D. Kelly. E.P. 504,751, 1.5.39. Appl. 1.11.37. Condensing hydrocarbon gases and vapours for storage and transport purposes in light-weight containers using low pressure, by means of absorbents surrounded by solid CO_2 and arranging for the circulation of cold air through and around the condensing vessels.

H. Dreyfus. E.P. 505,121, 5.5.39. Appl. 6.11.37. Manufacture of hydrocarbons and their oxygen-containing derivatives from CO and H_2 at high temperatures using as catalyst Co promoted with thoria.

W. H. Walton. E.P. 505,302, 9.5.39. Appl. 10.3.38. Apparatus for detecting, indicating, or recording the presence of inflammable gas in mines of the type in which the catalytic action at the surface of an electrically-heated Pt or Pt alloy filament, causes a change in temperature of the filament.

Oldham & Sons, Ltd., and H. Holt, Jr. E.P. 505,565, 11.5.39. Appl. 11.11.37. Apparatus for use in detecting inflammable gas and/or vapour.

G. L. Mateer and W. H. Rupp. U.S.P. 2,157,343, 9.5.39. Appl. 18.9.36. Process of recovering gasoline from hydrocarbon gas mixtures.

F. E. Frey. U.S.P. 2,159,434, 23.5.39. Appl. 27.6.36. Separation of isobutene from butene-2 by passing the hydrocarbon mixture containing butene-2 and *iso*butene past one side of a rubber membrane when the butene-2 dissolves in and passes through more readily than the *iso*butene. The gases containing butene-2 in a more concentrated state are then removed from the opposite side of the membrane.

W. S. E. C.

See also Abstract No. 948.

Cracking.

873. Effect of Gravity of Oil on Cracking Plant Costs. W. L. Nelson. *Oil Gas J.*, 6.4.39, **37** (47), 55.—The relation between the equipment cost and profitability of three cracking plants of capacity 1500 brl. per day of reduced crude and the gravity of their intakes (21°, 24°, and 27° A.P.I., respectively) is discussed. Low-gravity intakes produce less gas-oil, so that smaller cracking units are required. A diagram

illustrates the total cost and break-up into material, labour, overhead, and profit for reduced crude of different gravities. For 1500-brl. plants operating on 21°, 24°, and 27° A.P.I. reduced crude, the total cost is given as $195,049, $203,310, and $206,643, and the profit in cents per barrel charge as 10·9, 6·6, and 2·7, respectively. For each of the above plants to make a profit of $60,000 per year it would be necessary to obtain reduced crude at 50, 51, and 52 cents per barrel, respectively, and in order to make any profit, the raw gasoline must be evaluated at 3·39 c., 3·67 c., and 3·88 c. per gallon, instead of the 4 c. taken in the previous estimates. The break-up cost of a 1500-brl.-per-day cracking unit is given as: pipe still, stack, etc., 25·2%; fractionating tower and shell vessels, 8·3%; heat exchangers, 1·7%; condensers and coolers, 7·4%; pumps, 8·8%; pump-house and instrument-room, 1·2%; pipe, valves, and fittings, 12·2%; instruments, etc., 3·2%; utilities, 0·9%, tools, etc., 0·6%; supervision and operation, 2·8%; drafting, 1·7%; insurance, liability, etc., 4·5%; overhead and profit 21·0%. C. L. G.

874. Safety in the Design, Construction, and Maintenance of Combination Cracking Units. C. W. Nofsinger and J. V. Hightower. *Refiner*, 1939, **18**, 73 and 123.—Safety records in the petroleum-refining industry disclose, over the last decade, a marked decline in the rate of accidents and fatalities. The above authors give a comprehensive general discussion on the progress in the evolution of safety measures as directed towards the installation of a combination cracking unit under safety in design, pump installations, protection of pipe, control instruments, electrical equipment problems, safety in construction, hoisting machinery, maintenance, and instruments. G. R. N.

875. Use of a Salt-Removal Drum to Reduce Corrosion. J. C. Albright. *Petrol. Engr*, May 1939, **10** (6), 80.—The installation of a salt-removal drum between the charge pump and the main fractionating column of a cracking plant virtually eliminated corrosion in the plant. The oil charge is heated and mixed with a controlled amount of water to dissolve the salt. Heating of the mixture breaks the oil film surrounding the salt crystals. The operation of heating, mixing and settling is automatic when the proper balance has been established. The cost of the operation is more than offset by the saving in the life of the equipment. R. J. E.

876. Patents on Cracking. Houdry Process Corp. E.P. 505,368, 9.5.39. Appl. 9.11.37. Production of motor fuel by catalytic cracking and pyrolysis of hydrocarbons of wide boiling range. The cracking and pyrolysis are carried out in independent stages and the products blended from both stages.

Universal Oil Products Co. E.P. 506,849, 6.6.39. Appl. 1.2.38. Reforming of hydrocarbon-oil distillates of the gasoline boiling range, accompanied by thermal treatment of relatively high-boiling normally gaseous hydrocarbons, including propene and/or butenes, for the production of high yields of gasoline of controlled vapour pressure and good anti-knock value.

C. C. Chaffee. U.S.P. 2,158,353, 16.5.39. Appl. 19.4.35. Production of motor fuel by a combined process of cracking and polymerization of high-boiling normally liquid hydrocarbons and normally gaseous hydrocarbons.

W. T. Hancock. U.S.P. 2,158,365, 16.5.39. Appl. 4.3.38. Oil-refining system in which cracking stock is preheated below cracking temperature and cracked and then followed by fractionation.

V. Voorhees. U.S.P. 2,160,239, 30.5.39. Appl. 10.7.34. Apparatus for the heat treatment of hydrocarbons consisting of a combustion chamber in which the hydrocarbons are rapidly raised to high temperatures by heat-exchange relation with molten material.

H. E. Drennan. U.S.P. 2,160,249, 30.5.39. Appl. 25.7.36. Process of increasing the anti-knock qualities of hydrocarbons boiling in the gasoline range by contacting them in the vapour phase at 500–1500° F. with gypsum at a flow rate to cause only a minor amount of cracking. W. S. E. C.

See also Abstract No. 923.

Hydrogenation.

877. Liquid-Phase Hydrogenation of Pittsburgh Seam Coal. L. L. Hirst and others. *Industr. Engng chem.*, 1939, **31** (7), 869.—Quantitative procedures for the hydrogenation assay of American coals have been developed. This work involved the perfection of mechanical equipment for continuous operation of the experimental plant and the development of relatively simple and accurate quantitative tests. All the work reported was carried out on Pittsburgh seam coal from the Bureau of Mines experimental mine at Bruceton, Pennsylvania. Assay work on this coal has been completed. Further modifications which have been found necessary for the smooth operation of the plant are reported. Data are presented concerning the effect of varying temperature, contact time, pressure, and hydrogen recirculation rate.

The assay comprised determination of the optimum conditions in liquid-phase hydrogenation for the maximum yield of a " middle " oil consistent with the complete regeneration of the vehicle used in making paste with the original coal.

For Bruceton coal the optimum conditions found were, temperature 400° C., pressure 200–300 atmospheres, 2·75 hr. contact time, and hydrogen circulation rate 100 cu. ft. per hour (measured at 20° C. and 760 mm. pressure). Under these conditions a yield of 66% of " middle " oil (containing 20% boiling in the gasoline range and 80% boiling below 330° C.), and 20–25% of hydrocarbon gases (methane–butane) is obtained in a single pass through the converter. The loss 9–14% consists of 6–8% of unreacted carbonaceous material (fusain and opaque attritus) and 3–6% of oxygen, nitrogen, and sulphur hydrogenated to water, ammonia, and hydrogen sulphide. The " middle " oil contains 15–18% of tar acids and from 3 to 5% of tar bases, and the remaining neutral oil contains 6–8% olefines, 67–70% aromatics, and 22–27% saturated hydrocarbons. H. E. T.

878. Patents on Hydrogenation. G. W. Johnson. E.P. 504,349, 19.4.39. Appl. 19.10.37. Process for low-temperature carbonization or distillation of carbonaceous residues containing oil and solids such as are formed in the destructive hydrogenation of coal-tars or mineral oils, in a rotating drum supplied with filler bodies.

P. Marécaux. U.S.P. 2,159,281, 23.5.39. Appl. 26.5.36. Hydrogenation of carbonaceous substances containing sulphur in the presence of a catalyst adapted to transform carbonaceous compounds into carbonaceous products of lower boiling point. The mixture is subjected during hydrogenation to the action of an absorbing substance adapted to absorb H_2S so as to keep the H_2S content of the mixture between 0·1% and 1%.

M. Pier, W. Simon and P. Jacob. U.S.P. 2,159,511, 23.5.39. Appl. 9.1.35. Hydrogenation of carbonaceous substances heavier than gasoline in the presence of metal sulphide catalysts prepared from thio salts. W. S. E. C.

Polymerization.

879. Thermal Poly Process Adapted to Small Gasoline Plant. Anon. (Summary of Paper by D. M. Wilson to Nat. Gas Assoc.). *Nat. Petrol. News*, 17.5.39, **31** (20), R. 194–R. 202.—A small thermal polymerization plant has been in operation for some time, producing 17,000 gals. polymer gasoline from 40,000 gals. butane daily. The plant is typical of those designed for installation at natural gasoline plants. Cost and yield figures in comparison with those pertaining to two larger plants are presented. H. G.

880. Midget Polymerization Units. W. B. Shanley and G. Egloff. *Oil Gas J.*, 18.5.39, **38** (1), 116.—A selection of five out of the fifty U.O.P. catalytic polymerization units in commercial operation, under design or under construction, has been studied from the point of view of differences in cracking stock, effect of combination topping and cracking, variation of olefin content of gases (19–41%) and size of plant (125,000 cu. ft. to 800,000 cu. ft. per diem).

While the total cracked gases may be polymerized, the stabilizer gas represents only one-third of the total volume, but contains two-thirds of the polymerizable hydrocarbons. However, owing to the lower olefin content of the total gas, it is simpler to control the temperature in the catalyst-bed, which falls as the activity of the catalyst decreases. A catalyst life of over 70 gals. per lb. has been attained, 3870 lb. being an average figure. The utilities required for a unit processing 500,000 cu. ft. of gas are: fuel 650,000 B.Th.U. per hr., water 4000 gals. per hour, process steam 550 lb. per hour, and compressor power 35 h.p.

Where the sulphur content of the polymer gasoline is important, H_2S should be removed from the intake, as it reacts with olefins to give mercaptans. As a rule a sulphur content of 0·3–0·4% in the polymer gasoline is permissible, and this may be obtained by treatment with strong caustic solution or by the U.O.P. copper-sweetening process.

Olefin conversions amount to 85–95%, the *iso*butene polymerizing rapidly, butene 2 less so, and butene 1 with some difficulty. Sufficient C_4 fraction is retained in the polymer gasoline to give a vapour pressure of 18·8–30·9 lb.

The effect of catalyst-bed temperature is shown by a table in which an olefin conversion of 95% at 452° F. is reduced to 76·5% at 406° F.

In two of the units the percentage conversion of individual hydrocarbons was: ethylene 44% and 35%, propene 89% and 98%, butene 1 and 2, 71% and 92%, and *iso*butene 92·3% and 94%. Deep stabilization of cracked gasoline is recommended in order to release the maximum quantity of butenes for polymerization, and allow the maximum quantity of unreacted butane to be retained in the polygasoline. The end-point of the gasoline varies with the activity of the catalyst, but is fairly easy to control.

In the case of a reforming unit producing 76% of 70 O.N. gasoline the yield was increased to 84% and the O.N. by 1·5 to 2, on the addition of a polymer plant, the blended gasoline showing, however, an actual road-rating equivalent to 75 O.N.

Several midget *iso*-octane plants are under construction, operating on butane–butane from the stabilizer, which is caustic-treated before processing and selectively polymerized at 700 lb. and 260–325° F. The crude polymer is distilled to give 90–95% of an *iso*-octenes fraction of 85·5 O.N., the *iso*-octenes being hydrogenated at 75 lb. and 325° F. in the presence of a nickel catalyst, yielding mixed *iso*-octanes of 95 O.N. The bottoms may be hydrogenated to give safety aviation fuel. At present midget *iso*-octane plants are uneconomic in the U.S.A. although required in other countries. They also represent a valuable potential source of further supplies of aviation fuel. C. L. G.

881. Patents on Polymerization. Standard Telephones & Cables, Ltd., and S. G. Foord. E.P. 504,765, 1.5.39. Appl. 24.12.37. Method of stabilizing styrene against further polymerization.

Houdry Process Corp. E.P. 505,369, 9.5.39. Appl. 9.11.37. Process of polymerization of hydrocarbon gases containing olefines and cracking or dehydrogenation of gases to produce olefines capable of polymerization.

V. N. Ipatieff and R. E. Schaad. U.S.P. 2,157,208, 9.5.38. Appl. 20.9.37. Polymerization catalyst for the polymerization of normally-gaseous olefines present in cracked gas mixtures. The catalyst is prepared by mixing tetra-phosphoric acid and a siliceous adsorbent and calcining the resultant mixture.

H. C. Schutt. U.S.P. 2,157,220, 9.5.39. Appl. 26.3.34. Motor fuel prepared by blending a stabilized motor fuel containing cracked and polymerized distillates.

C. R. Wagner. U.S.P. 2,157,224, 9.5.39. Appl. 21.4.33. Process of simultaneously polymerizing hydrocarbon gases rich in olefines and reforming naphtha.

C. R. Wagner. U.S.P. 2,157,225, 9.5.39. Appl. 21.4.33. Polymerization of gases rich in olefines at 850–1100° F. and under 500–2000 lb./sq. in. pressure in at least three stages, the second and third stages being at lower pressures than the first.

H. Haeuber and J. Hirschbeck. U.S.P. 2,159,148, 23.5.38. Appl. 30.6.38. Production of hydrocarbon oil by subjecting to polymerization (Friedel Crafts' reaction),

gases containing more than 30% of gaseous olefines chiefly butylenes and amylenes, and subjecting the product to both a hydrogenating treatment and treatment with superheated steam in the presence of caustic alakli.

P. A. Maschwitz. U.S.P. 2,159,746, 23.5.39. Appl. 31.5.35. Method for promoting and controlling the polymerization of hydrocarbon gases to heavier hydrocarbons.

R. F. Ruthruff. U.S.P. 2,160,286, 30.5.39. Appl. 17.12.34. Improved combination of an oil cracking unit, utilizing preferably crude oil as charging stock, and eliminating gasoline and heavy fuel oil as the principal liquid products, together with one or two polymerization units functioning to convert gas from the cracking unit into additional liquid products.

R. F. Ruthruff. U.S.P. 2,160,287, 30.5.39. Appl. 17.12.34. Production of gasoline from hydrocarbon gases containing olefines and butane by first separating these gases into a fraction containing ethylene as the predominant constituent which is thermally polymerized to obtain gasoline; a second fraction containing higher-boiling normally gaseous olefines and butane is subjected to catalytic polymerization to produce gasoline. The H_2 and CH_4 from the thermal polymerization, together with the remaining products and those from the catalytic polymerization, are passed to a common fractionating system. The unconverted gases and the gasoline containing substantial quantities of butane are recovered and recycled to the thermal polymerization system. W. S. E. C.

Synthetic Products.

882. Synthesis of Kogasin and Paraffin Wax in Aqueous Phase. F. Fischer and H. Pichler. *BrennstChemie*, 1939, **20**, 247–250.—The synthesis of kogasin and paraffin wax from CO and H by means of catalysts can be carried out with success only within a narrow temperature range. The heat of reaction must therefore be constantly removed with but little temperature fall.

It has been investigated whether the kogasin synthesis could be carried out successfully in the aqueous phase, with the catalyst suspended in superheated water (about 200° C.). Fe, Ni, Co, and Ru were tried as catalysts, but only the latter two were found to be effective, and to retain their activity in weak acid solutions. Ru is best, optimum results being obtained at high gas pressures and temperatures under 200° C. Quantity and quality of products obtained on Co and Ru are similar to those found in the mean-pressure synthesis.

In the aqueous phase the heat of reaction is effectively removed, for, with the pipe sections employed, yields would be very small in the absence of water. Catalyst activity diminishes more rapidly in the aqueous phase than in the dry phase, possibly, because the catalyst collects in less agitated portions of the liquid in the apparatus, and is consequently gradually withdrawn from the reaction.

It is concluded that synthesis in the aqueous phase is practically not feasible, because (*a*) results are not better than in the dry phase, (*b*) more space is needed, (*c*) the apparatus must be lined with acid-proof material, which makes it expensive, (*d*) a considerable amount of energy is consumed for violent agitation, and (*e*) continuous removal of products of reaction is difficult. L. R.

883. Patent on Synthesis. Ruhrchemie A.-G. and O. Evans. E.P. 504,910, 27.4.39. Appl. 27.7.37. Catalytic conversion of mixtures of CO and H_2 at ordinary pressures at 160–175° C. to increase the content of solid hydrocarbons that boil at high temperatures. Cobalt catalysts are used, activated by the addition of thorium oxide or magnesium oxide, and the speed of flow of the gas over the catalyst is not more than 20 litres per litre of catalyst per hour. In this way 50% or more of the CO entering the reaction is converted into paraffin wax. W. S. E. C.

Refining and Refinery Plant.

884. Catalytic Refining Methods. V. N. Ipatieff. *Oil Gas J.*, 30.3.39, **37** (46), 86.—A comprehensive survey of the two processes used for the synthesis of aliphatic

hydrocarbons, alkylation and polymerization, in the petroleum industry is given. The alkylation process differs from the Friedel–Crafts type of alkylation in that an olefine is used as alkylating agent rather than an alkyl halide. The mechanism of the reaction is explained by the interaction of an aluminium chloride/olefine complex with the paraffin. Similar results are obtained with boron fluoride as catalyst. The composition of the product obtained by the alkylation of *iso*butane with ethylene under given conditions shows that the hexanes are the predominating fraction. The method adopted for the separation of the hexanes from one another is described. The formation of *iso*pentane is attributed to a secondary reaction consisting of auto-destructive alkylation. The failure to alkylate propane is attributed to the absence of a tertiary C-atom, and the impossibility of isomerization to a compound containing such an atom. Support for this theory is given by the results obtained in the alkylation of naphthenes. Aluminium chloride affects the alkylation of *cyclo*hexane by isomerization to methyl*cyclo*pentane. Boron fluoride fails to produce isomerization, and hence does not affect the alkylation of *cyclo*hexane. The mechanism of the alkylation of aromatic hydrocarbons with various catalysts is described.

In the description of the catalytic polymerization of olefines, the effect of variation of reacting condition is fully discussed. The hypothesis of the intermediate formation of unstable esters with the acid catalyst is supported by the isolation and identification of such esters under modified reaction conditions. R. J. E.

885. Efficiency of a Rotary Distillation Column. B. J. Mair and C. B. Willingham. *Bur. Stand. J. Res. Wash.*, 1939, **22** (5), 519–527.—Of the major characteristics which describe a distillation column—the height equivalent to a theoretical plate (H.E.T.P.), the hold-up and the throughput—the latter is of least importance when the greatest possible separation is desirable.

This paper describes tests with respect to these characteristics with a hydrocarbon mixture in a rotary column, in which the type of plate, speed of rotation, and throughputs were varied.

A full description is given of the rotary distillation column which had a rectifying section 56 cm. long and 5·08 cm. diameter. Three types of rotating members were used: (*a*) baskets with fine holes, (*b*) flat plates, (*c*) cones, and tests of separating efficiency were carried out at speeds of rotation from 250 to 1500 r.p.m. and throughputs 1–10 ml. liquid per minute. The hydrocarbon mixture methyl*cyclo*hexane/*n*-heptane served as the test liquid.

The lowest H.E.T.P. was obtained with the conical rotating members spaced 0·64 cm. apart, with which the following average results were obtained: H.E.T.P., 1·04 cm.; hold-up, 1·3–1·6 ml. liquid per theoretical plate; maximum throughput, 10 ml. liquid per minute. Within the reproducibility of these experiments there was no variation in H.E.T.P. for throughputs from 2–10 ml. liquid per minute, and speeds of rotation from 250–1500 r.p.m. D. L. S.

886. Theory and Development of High-Vacuum Distillation. C. R. Burch and W. J. D. van Dijck. *J. Soc. Chem. Ind.*, 1939, **58**, 39–42.—Molecular distillation is characterized by the use of permanent gas pressures so low (10^{-6} atm.) as to play no essential part in determining the speed of distillation, or even whether distillation takes place or not.

The historical development of this method of distillation and the theoretical considerations governing the process are outlined, and factors limiting the large-scale application are discussed.

The invention of the "self-pumping still"—*i.e.*, a still in which the distilling vapours themselves force the uncondensable gases to the place at which the pump can handle them—was of great importance for further technical development. Two types of "self-pumping" stills, which remove the limits set by the finite rate of gas flow in the still itself, are described.

Not every distillable product can be distilled in the ultra-high vacuum units. During experiments by the authors it has been found that some oils show slight decomposition, producing only traces of gas, which, however, upset the molecular distillation by causing severe splashing and subsequent contamination of the distillate. This latter problem appears to be the only limitation to the application of molecular distillation on a large scale. T. C. G. T.

887. Carbonization of Acid Sludge. V. K. Shchitikov and G. N. Krutikov. *Neft. Khoz.*, March 1939, **20** (3), 34–38.—Acid sludge has been carbonized in a batch still yielding coke, coking distillate, acid water, and gas. The present report is concerned with an examination of the coke and the coking distillate obtained.

The carbonization process produced, depending on the type of oil treated: 14·2–19·7% coking distillate, 33·3–34·8% coke, and 27·3–37·3% gas + loss. The coke contains on an average 2·65–3·85% ash and 2·21–3·37% sulphur. It is not suitable for electrode manufacture, but can be used as a fuel.

The coking distillate contains: 22·8–26·3% gasoline distillate, 25–29·3% kerosine distillate, and 42·7–49·3% residual oil. By treating the gasoline distillate with sulphuric acid (2%) and with Zikeyev filter clay in the vapour phase, a gasoline of good stability was obtained. With addition of α-naphthol (10 mg./100 c.c.), the gasoline contained after two months storage 5·6 mg. gum, and had an octane number of 79.

Similar treatment of the kerosine distillate did not give satisfactory results. The product was very dark and had a natron test of 3–4.

The residual oil contains 1·45% sulphur and can be used as a boiler fuel. Asphalt produced from it conforms to the Russian Standard No. II. L. R.

888. Design and Operation of Depropanising Plant. J. C. Albright. *Refiner*, 1939, **18** (4), 131.—Hancock Oil Co. at Signal Hill, California have recently installed a new gasoline plant. The chief features are the three distillation columns. In the first column straight-run gasoline is stabilized to a 81·5% recovery and is sent to storage. In the second column pressure distillate is stripped to approx. 91·6% recovery, and also goes to storage. The third tower handles the overhead, chiefly butanes and propane, from the other two towers plus the raw gasoline from an absorption plant. The stabilized condensate from this stage is used to control the vapour pressure and augment the final blend of straight and cracked gasoline. In all three columns the reboiler fluid is heated refinery gas oil. G. R. N.

889. Uses of Oxygen and Acetylene in the Refinery. H. Jouette. *Refiner*, 1939, **18** (4), 161.—A concise account of the uses of oxygen and acetylene, based on practical experience, in welding, salvage, demolition and metal spraying. G. R. N.

890. Portable Heater for Small Heating Loads. F. L. Kallam. *Refiner*, 1939, **18** (4), 163.—The Millard heater is described. It is a readily portable unit consisting of a rigid circular steel shell mounted on an I-beam skid. The only foundation required is a set of timbers or concrete piers. The heater tubes are placed around the periphery of the firing-chamber and are connected by means of conventional junction boxes. Gas or fuel-oil burners can be used, and firing is through the centre of the long combustion chamber or shell without flame impingement on the tubes. Heating is entirely radiant, but higher thermal efficiency can be attained by adding a second circular shell of identical construction, placing it directly above the primary radiant heater, and using it as the convection section. A double heater of this type with a heat release of 9,000,000 B.Th.U. per hour weighs only 40,000 lb. Since the heater can be shop fabricated, air-setting refractory is used. This material is much lighter than firebrick or cast refractories, and does not crumble or spall at furnace temperatures of 2300–2400° F. The heater can be operated up to 300 lb. working pressure with a coil outlet temperature of 650° F. G. R. N.

891. Solutizer Process for Extraction of Mercaptans. D. L. Yabroff and L. E. Border. *Refiner*, 1939, **18**, 171.—Suitable organic solvents or solutizers have been found, which will improve the mercaptan extracting power of aqueous alkaline solution. For commercial purposes a solutizer must not be decomposed or changed in either cold or hot alkaline solutions, must be very soluble in aqueous caustic but only slightly soluble in gasoline, and its vapour pressure at elevated temperatures must be low, so that steam regeneration can be employed. Sodium and potassium *iso*butyrates are good solutizers with the corresponding hydroxides—a typical treating reagent consists of 3*N*-*iso*butyrate salt in 4–6*N*-hydroxide solution. Several types of gasoline have been treated in a 250-brl. pilot plant. A 95–250° F. cracked gasoline, which

could not be sweetened with 40% by vol. of 15–45° Bé. caustic, was readily sweetened by three-stage extraction using 20% of the solutizer reagent. The regenerated solutizer has a high mercaptan content, but has no adverse effect on its subsequent use. Solutizer treatment does not affect octane number, but improves the lead susceptibility of the gasoline. Solutizer reagent removes effectively alkylphenols, leaving the gasoline unstable. This can be overcome by using a mixed solutizer containing alkylphenolate salts, the treated gasoline then having a definite alkylphenol content. G. R. N.

892. Field Installation of Chromium Sheet Linings in Pressure Vessels. J. T. Shaler. *Refiner*, 1939, **18**, 183.—A comprehensive account of the experience of the Standard Oil Co., California, in lining pressure vessels with chromium steel during the past ten years. Primarily installed for corrosion resistance, the linings described also possessed a desirable heat insulating characteristic, which protects the vessel against thermal shock. It is shown that uncontrolled introduction of water into unlined vessels can induce stresses exceeding the proportional limit of the shell metal, whereas the lining limits cooling rates to safe values. Full details and drawings are given. G. R. N.

893. Multi-Layer Construction of Thick-Wall Pressure Vessels. T. M. Jasper. *Refiner*, 1939, **18**, 193.—The largest vessel of multi-layer construction built by A. O. Smith weighs 110,000 lb. Vessels of this kind are used for hydrogenation at high temperatures, high-pressure chemical processes, etc. In construction, successive layers of steel are wrapped around a cylinder, being tightened and welded together. The outer layers are usually less than $\frac{1}{4}$ in. in thickness; the innermost may be thicker. The innermost layer must be leak-proof and be chosen for the purpose desired, whereas the outer layers can have perforations. When the layers are in place the ends are machined for a welding groove. The sections are assembled and welded as solid-wall vessels are. One of the advantages of this type of construction is that it gives opportunity for close scrutiny of the material. In addition, the cost of the plant necessary for the manufacturing process is also less. Stress-relieving is not necessary, and is not recommended. When failure of multi-layer vessels takes place under pressure there is deformation, and no shattering data and photographs are given. G. R. N.

894. Metal Spray Protection of Refinery Equipment. D. R. Johnson and E. K. Dewey, Jr. *Refiner*, 1939, **18**, 199.—In January 1934 the Continental Oil Co. metallized two Dubbs reaction chambers to check corrosion. In October 1934 the coating had peeled badly at the domes, so the surfaces were sand-blasted and re-sprayed with ten coats of aluminium to a total thickness of 0·018 in. This proved successful, and since then the average annual metallizing replacement has been 4–5%, a figure that would be lower but for the rotary cleaners. Similar success was obtained in metallizing the lower sections of bubble towers, a lubricating-oil contact kettle, pump-rods, etc. In sand-blasting a surface of metallizing, the blast should be directed at an angle of about 60° to the surface. First-quality blasting sand only should be used. Blasting should only proceed at such a rate that spraying can quickly follow it. All coke or oil must be removed. The air supplied to the metallizing gun must be dry, and the coating must be evenly applied. The best results have come from applying individual coats from 0·0015 to 0·0020 in. thick. Twelve-gauge wire is preferred, but eleven-gauge is under test. Costs of metal spraying depend in the metal and the area to be covered, and may vary from 0·70 to 2·25 dollars per sq. ft. G. R. N.

895. Condenser Tube Alloys Improved by Antimony. Anon. *Nat. Petrol. News*, 17.5.39, **31** (20), R. 208.—It is claimed that small additions of antimony to brass, including aluminium brass and Admiralty Metal, increase water-corrosion resistance. 0·02% sb. added to 65% α-brass prevents dezincification. As little as 0·007% sb. greatly increases water-resistance, although dezincification still occurs. In this respect antimony alloys are superior to those containing arsenic, since the latter does not inhibit dezincification and may induce inter-crystalline corrosion. H. G.

896. Corrosion-Resistant Linings Reduce Shutdown Time. Anon. *Nat. Petrol. News*, 17.5.39, **31** (20), R. 211.—Summary of A.P.I. May papers.

J. T. Shaler. "Field Installations of Chromium Sheet Linings in Pressure Vessels."

D. R. Johnson. "Metal Spray Protection of Refinery Equipment."

R. K. Hopkins. "Pressure Lining of 11–13% Chromium Steel."

The economic loss due to shut-down time can be reduced by the use of water to cool the vessels to a temperature safe for opening. The use of corrosion-resistant linings, by lowering the maximum temperature differential during cooling, greatly reduces the warping hazard. Vessels have been lined *in situ* by a variety of methods and with a variety of materials. Low carbon, 11–13% Cr sheet spot welded into position, and metal-spray coating with 18–8 stainless steel or aluminium are typical examples of processes which have proved to be successful. H. G.

897. Stainless Steel Applications which Reduce Corrosion. K. E. Luger. *Nat. Petrol. News*, 17.5.39, **31** (20), R. 221.—Recent applications of stainless steel to refinery practice include the use of stainless-steel bubble caps, trays, risers, and hold-down bars. Costs have been reduced by reducing tray thickness to as little as 0·0625 in., the necessary strength being imparted by special designing. Immunity from corrosion, the minimizing of coking and reduction of labour costs owing to the weight reduction, and the ease with which coke is removed from a non-corroded surface are the principal advantages gained. Old reaction vessels have been successfully lined with stainless steel "on the job." 18–8 welding-rod has been used for the building up of worn parts such as valve-bodies, pump-plungers, and valves. H. G.

898. Light-metal Fractionating Apparatus. J. N. Belsen. *Oel u. Kohle*, 1939, **15**, 363–366.—Corrosion tests have shown that pure aluminium is attacked less by the sulphur- and cyano-compounds in crude benzol than is cast iron, so it is suggested that aluminium should be used in the construction of benzol plants. In order to keep costs reasonably low, it is essential that fractionating columns, etc., should be constructed of a number of serial units of standard dimensions, so that these units may be produced on a comparatively large scale, instead of each column being made to individual specifications.

The construction of a unit on these lines is described in some detail and the work illustrated with photographs and diagrams.

A de-benzolizing plant capable of dealing with 10 tons of wash-oil per hour weighs only 1 ton when made of aluminium, compared with 7·5 tons if of iron, costs little more initially, and is cheaper to run. T. T. D.

899. Dimensions of Pipe-Stills. W. L. Nelson. *Oil Gas J.*, 11.5.39, **37** (52), 63.—A mathematical analysis of the cost of construction of pipe-stills is presented in order to provide a method of determining the most economical pipe arrangement. This is based on factors such as the higher cost of many short tubes over that of fewer long tubes, and the high cost of a return bend (which is regarded as equivalent to 18 ft. of tubing, 3–4 sq. ft. of roof, 12–13 sq. ft. of floor, foundations, etc., 4–5 sq. ft. of walls, header boxes, etc. C. L. G.

900. Steam and Air used to De-Coke Still Tubes in New Method. T. E. Garrard. *Nat. Petrol. News*, 19.4.39, **31** (16), R. 146.—In the method described the furnace is heated to a temperature of 1100–1300° F., depending on the nature of the coke deposit, and steam at about 100 lb./sq. in. inlet pressure is admitted. The rate of steam flow, which has a maximum of about 3000 lb./hour, is adjusted according to the character of the coke removed in the steam stream. The removal of coke usually commences in about 1 hr. Too high steam pressure and/or rate of steam flow may result in undue erosion of the tubes if the coke is removed in a coarse form. Air is admitted in increasing quantity with the steam as the rate of coke removal diminishes. The last of the coke is thus burned off. The method is claimed to be no more expensive than the conventional methods and may be much cheaper, the noise and dust

nuisance associated with the use of rotatory scrapers is eliminated, and continuous welded construction of the tubes is possible. The disadvantages of the system are :—

(*a*) That the coke seal between the old tubes and the heater boxes is burned away, resulting in leaks at those points.

(*b*) Whether or not the high temperatures reached result in accelerated spreading, distortion of the heaters is still debatable. This effect would be very undesirable, but is evidently not great.

(*c*) The system calls for skilled operators. H. G.

901. Entrainment in Plate Columns. E. M. Baker. *Industr. Engng Chem.*, 1939, **31** (6), 717.—The McCabe-Thiele graphical method for determining the number of plates required for the separation of a binary mixture is modified to allow the effect of entrainment to be introduced. P. D.

902. Choice of a Low-Temperature Insulating Material. K. M. Ritchie and C. C. Vogt. *Industr. Engng Chem.*, 1939, **31** (7), 821.—The conditions of service to be met by a suitable low-temperature insulation include, besides those common to most insulating problems, the question of the possibility of moisture condensing inside the lagging, and so spoiling its efficiency. This can sometimes be overcome by placing the lagging on the inside of the chamber.

A general discussion of this and other effects is given. P. D.

903. Heat Insulation. J. Z. Finck. *Industr. Engng Chem*, 1939, **31** (7), 824.—The three means by which heat is transmitted through an insulation—namely, thermal conductivity of the solid material and the air, convection in the air spaces, and radiation—are discussed. Equations are given for calculating the quantities of heat transmitted by these means, together with illustrative examples. P. D.

904. Silica Aerogel. Effect of variables on Thermal Conductivity. J. F. White. *Industr. Engng Chem.*, 1939, **31** (7), 827.—The conductance of silica aerogel rises with temperature, owing to the fact that it is transparent. This may be overcome by incorporating in the gel some opaque material, which may be either reflecting or non-reflecting. It was shown experimentally that the former type was best, the best lagging being produced by the incorporation of 15% silicon, which gives a gel with conductivity near that of still air.

The effect of the apparent specific gravity of the aerogel on the thermal conductivity was also investigated. P. D.

905. Reflective Insulation. G. B. Welkes. *Industr. Engng Chem.*, 1939, **31** (7), 832.—The theory of reflective insulation is given, and the results of tests on aluminium foil insulations are described. Typical figures for heat losses from roofs, ceilings, and walls are also given. P. D.

906. Relation between Catalytic Activity and Size of Particle. E. W. Thiele. *Industr. Engng Chem.*, 1939, **31** (7), 916.—In the case of reaction taking place on the surface of a solid catalyst which is used in the form of porous grains, two regions can be considered. If the reaction rate is high and the grain size or particle size is small, the activity is proportional to the amount of catalyst present, since the whole surface, both external and internal, is operative. As the grain size is increased, the effects of diffusion of the reactants into the interior of the grains and of the product outwards become noticeable, the activity of the centre of the grain decreasing, until in the limit the activity depends only on the external surface of the grains.

The problem is treated mathematically considering the catalyst grains to be flat plates or spheres. Several cases are considered for a first-order reaction, no change of volume, reaction increases volume, and reaction decreases volume.

The case of a second-order reaction with no change of volume using flat plates of catalyst is also treated.

It is shown that for a first-order reaction the ratio of actual activity to maximum activity remains high (*i.e.*, above 0·7) for values of the modulus $x_s\sqrt{(c/rk)}$ less than unity, using consistent units.

x_s = radius of grains (spheres),
c = activity of unit internal surface of the pores,
r = hydraulic radius of the pores,
k = diffusion coefficient.

P. D.

907. Patent on Distillation. A. R. Nevitt. U.S.P. 2,159,566, 23.5.39. Appl. 24.9.36. Distillation apparatus for hydrocarbon oils. W. S. E. C.

Fire Prevention.

908. Modern Fire-Fighting. J. R. Howcroft. *Chem. & Ind.*, 1939, **58**, 323—329.—The use of vaporizing liquids—*e.g.*, carbon tetrachloride—of carbon dioxide, chemical foam, and mechanical foam for extinguishing fires is traced from the infancy of each to present-day equipment and technique. The suitability of each type for special purposes is discussed. T. C. G. T.

909. Recent Developments in Apparatus for Automatic Extinction of Fires. Anon. *Chem. & Ind.*, 1939, **58**, 439.—Automatic sprinklers based on the fusion of low-m.-pt. alloys, or the rupture of a heat-sensitive diaphragm are well known. The technique of light-sensitive cells, which, in the presence of a flame release a fire-extinguishing material, is developing, and lends itself to cases where instantaneous action is vital—*e.g.*, in the manufacture of highly inflammable compositions by kneading on hot rollers.

An interesting apparatus involves the ignition of a small amount of explosive to give instant rupture of a diaphragm and subsequent release of large volume of fire-extinguishing material.

French patents 826,050 and 826,882 are reviewed. T. C. G. T.

910. Modern System of Fire Protection. Anon. *Chem. & Ind.*, 1939, **58**, 439.—A general review of the advantages of the CO_2 method of fire extinguishing. Particular stress is laid on the fact that some fire-extinguishing materials are liable to cause more damage than the fire they extinguish. Such possibilities are obviated by the use of CO_2. T. C. G. T.

911. Some Methods of Fire Extinguishing. A. M. Cameron. *Chem. & Ind.*, 1939, **58**, 522–527.—Methods of extinguishing fires are traced from their infancy, when water alone was used, to present-day technique. Dry-powder extinguishers are still in use. These depend on either the evolution of an inert gas on heating or on the formation of a fire-proof crust on the burning material—*e.g.*, sodium bicarbonate, silicates, phosphates, borax, and microcosmic salt.

The plunger and turnover types of bicarbonate–acid extinguishers are reviewed.

Halogen extinguishers receive due attention, and it is pointed out that carbon tetrachloride has been used with safety on short circuits up to 200,000 volts. The non-conductivity of these materials makes them very suitable for electrical fires. Methyl bromide is finding extending use, particularly for aircraft, although it is more costly than CCl_4.

It is evident that the CO_2 system has many advantages, especially its cleanliness, great dielectric strength, and non-toxicity. It is noted that certain metals—*e.g.*, magnesium and the alkalis—will burn in CO_2.

Chemical foam systems are largely used in the oil industry. An example is aluminium sulphate or ferric aluminium sulphate and sodium bicarbonate. A foam stabilizer such as saponine or liquorice is added. General practice is to keep tanks full of the necessary solutions and to run mains through the tank farms or to use powder which is fed through hoppers into the water-hose. The necessary precautions for this latter technique are outlined.

Mechanical foam has developed over the last twelve years. In this case only a very small quantity of foam stabilizer is required, and it is fed by a special device into the

water-jets, together with a controlled amount of air. 2 lb. of stabilizer and 100 gal. of water will produce a 1000 gal. of foam. The stabilizer is carried in a small tank on the back of the fireman.

"Xaust Suds" is a type of mechanical foam which utilizes petrol engine exhaust gas instead of air for the production of the foam.

The "Mulsifyre" system, which is applicable mainly to oil fires, depends on the ability of a number of jets to impinge water on the surface of the burning oil in a manner sufficient to cause a surface emulsion. Water pressures of 40 lb. are required for heavy oils, and a somewhat higher pressure for petrol.

The sprinkler system, alarm valves and stop valves, together with their automatic accessories, are briefly outlined. T. C. G. T.

Chemistry and Physics of Petroleum.

912. Auto-oxidation of Simple Hydrocarbons in Relation to the Auto-oxidation of Lubricating Oils. H. Hock. *II^me Congrès Mond. Pétrole*, **2** (Sect. 2), Proceedings II, 803–806.—Auto-oxidation of solid fuels, of tars and tar-oils, and of motor fuels is discussed, the ageing of oils being regarded as connected with auto-oxidation.

The auto-oxidation of mineral oils is complex, but a solution of the problem has been attempted by quantitative determinations of the peroxides contained in the mineral oils. J. L. E.

913. Oxidation of Mineral Oils. N. I. Tchernojoukov. *II^me Congrès Mond. Pétrole*, **2** (Sect. 2), 797–802.—The author has investigated the oxidation of individual hydrocarbons and mixtures. Naphthenic hydrocarbons show increasing tendency to oxidize with increasing molecular weight and number of side-chains. The principal oxidation products are acids, mainly insoluble in ether, which form deposits in the course of oxidation. Highly refined oils containing no aromatics and resins are more liable than others to oxidation. The oxidation of mixtures of aromatic and naphthenic hydrocarbons has been studied. The presence of aromatics reduces the tendency of naphthenes to oxidize and prevents the formation of deposits. It is concluded that the stability of oils towards oxidation is essentially determined by the aromatic content. Resinous bodies have been found to act as inhibitors in preventing the formation of acid products. Modern methods of refining which are based on the removal of aromatic hydrocarbons by solvents are consequently not entirely satisfactory. S. R.

914. Oxidation of Naphthene-Base Oils by Oxygen. Parts 2 and 3. K. I. Iwanow. *Petrol. Z.*, 1938, **34** (33), 1–7; (34), 1–6.—The work described in Part 1 (see Abstract No. 164, 1939) was extended by varying the conditions of the experiment singly, the following observations being made:—

1. *Influence of Time*: T. = 150° C.; $p(O_2) = 15$ at.—Rate of production of carboxylic-acid groups was determined, the acids being isolated and their ultimate analysis carried out at successive stages. In addition, unsaponifiable oxygen compounds were isolated, determined, and subjected to ultimate analysis.

The results of this investigation indicate that the rates of oxidation of similarly refined paraffinic and naphthenic oils are equal or nearly so.

In all cases, reaction starts only after a short induction period, then proceeds rapidly, with a subsequent retardation in rate.

The more highly refined fractions are in each case the more rapidly oxidized.

In the case of the low-grade raffinates, little change in yield of acid bodies or in saponification value was observed under these conditions after 3 hrs. up to the final time of 14 hrs. The author attributes this fact to negative catalytic action on the part of tarry reaction products.

Carboxylic acids are the principal products of the oxidation. The rate of production of high-mol.-wt. acids is greater the more highly refined the oil. The quantity of carboxylic acids produced is at first proportional to the period of oxidation, but remains constant or decreases after a few hours. With the highly refined fractions, the quantity decreases after about 4 hrs., the further increase in acidity being due to formation of low-mol.-wt. hydroxy-acids. It is suggested that the latter are oxidation products of the high-mol.-wt. acids.

In all cases the unsaponifiable residue was shown to have a small but definite oxygen content.

2. *Influence of* $p(O_2)$: $t = 3$ hrs. ; T. = 150° C.—Oxygen and also air were employed at various pressures and partial pressures of O_2. The oxidation products from all four fractions were examined as in 1 (above).

It was found that the extent of oxidation is directly proportional to $p(O_2)$. The coefficient is slightly higher with the paraffinic oils. It is also higher the more highly refined the oil fraction.

Examination of the products, as before, shows that alteration of pressure of oxygen (2–15 at.) or air (25–60 at.) does not sensibly alter the course of the reaction in a manner comparable with the effect of changing time at constant $p(O_2)$ (1, above).

The observed proportionality between $p(O_2)$ and rate of oxidation excludes the possibility of heterogeneous reaction. The oxidation is homogeneous, and is brought about by O_2 dissolved in the liquid phase.

3. *Influence of Ratio : Exposed Surface/Volume.*—In the cases of the low-grade raffinates, increase of the surface–volume ratio affects the reaction in a manner similar to increase of time at constant $p(O_2)$ and T. (1, above).

The highly refined fractions were not completely examined. Under certain conditions the reaction proceeded with explosion.

4. *Influence of Temperature.*—Over the range examined (130–160° C.), increase in T. at constant $p(O_2)$ and time produces a strongly marked acceleration of oxidation, and affects the yields, properties, and ratios of carboxylic and hydroxy-acids in a manner comparable with the changes produced by the time variation above. The maximum temperature coefficient of oxidation (= 2) is shown between 130° C. and 150° C., the rate of acceleration being reduced at higher temperature.

5. *Influence of Container Surface.*—Increase in area of oil–glass interface, other conditions remaining equal, was found to retard oxidation. It is concluded that the reaction contains at least one stage in which oxidation involves a chain reaction, the reaction chains being broken at the solid–liquid interface.

Numerous graphs and tables of analysis figures are given, together with an extensive bibliography. C. G. G.

915. 2 : 6-Dimethylheptane : its Synthesis, Properties, and Comparison with an *iso*-Nonane from Petroleum. J. D. White, F. W. Rose, Jr., G. Calingaert and H. Soroos. *Bur. Stand. J. Res., Wash.*, 1939, **22** (3), 315–319.—The isolation from a mid-continent crude of an isomeric nonane, b. pt. 135·2° C., tentatively identified as 2 : 6-dimethylheptane, has already been described. In order to establish more definitely the identity of this material, synthetic 2 : 6-dimethylheptane was prepared by coupling *iso*butyl magnesium bromide with ethyl formate, producing 2 : 6-dimethylheptanol-4 in a 74% yield.

This was hydrogenated in three steps, and the product purified by treatment with 98% H_2SO_4, washing, drying, and refluxing over sodium–potassium alloy, and finally fractionating carefully in a column packed with crushed carborundum.

The purity of the synthetic hydrocarbon was found to be 99·6 mole-%, and its properties, extrapolated to a purity of 100 mole-%, were found to be as follows : b. pt. at 760 mm. Hg. 135·21° ± 0·02° C. ; f. pt. in air — 102·95 ± 0·10° C. ; density at 20° C. 0·70891 ± 0·00003 g./ml. ; refractive index n_D^{20} 1·400 73 ± 0·00005 ; aniline point 80·0° ± 0·3° C.

The properties of the *iso*nonane from petroleum are in good accord with those of the synthetic product. D. L. S.

916. Separation of Hydrocarbons of High Molecular Weight by Adsorption on Silica Gel. C. B. Willingham. *Bur. Stand. J. Res., Wash.*, 1939, **22** (3), 321–327.—Preferential adsorption by silica gel has been used for several years for separating mixtures of hydrocarbons, but no data have so far been reported concerning the effectiveness of separation of hydrocarbons of high mol. wt.

The apparatus used for this work was essentially the same as that described in a paper by Mair and White in 1935, except that both the silica-gel tube and the receiver were equipped with a heating-jacket. The four hydrocarbons used were synthetic materials, and experiments were carried out on binary mixtures. A sharp separation

of 5-(7-tetrahydronaphthyl)docosane from 5-(2-decahydronaphthyl)docosane and of *n*-dotriacontane from 1-(*p*-diphenyl)octadecane was obtained. Some separation of 1-(*p*-diphenyl)octadecane from 5-(7-tetrahydronaphthyl)docosane was found, but this was not so sharp as with the two preceding mixtures. No separation of *n*-dotriacontane from 5-(2-decahydronaphthyl)docosane was obtained.

For the first three mixtures cited above, the capacity of 20 gm. of the gel to absorb preferentially the more aromatic components was found to be 1·8, 3·3, and 0·8 gm., respectively. D. L. S.

917. Heats of Combustion of Tetramethylmethane and 2-Methylbutane. J. W. Knowlton and F. D. Rossini. *Bur. Stand. J. Res., Wash.*, 1939, **22** (4), 415–424.—Reliable values for these thermochemical constants are needed because of the present-day importance of the pentanes. Synthetic tetramethylmethane was purified until the final product contained only 0·3 mole %-impurity with a C/H ratio not far removed from the hydrocarbon itself. The 2-methylbutane was prepared at Brussels, and contained impurities estimated at less than 0·1 mole-%.

Both compounds were thoroughly dried and burnt in purified oxygen. Their heats of combustion in the gaseous state in O_2 at 25° C. and a constant total pressure of 1 atm. to form gaseous CO_2 and liquid H_2O were found to be: tetramethylmethane 3516·53 ± 0·94 international kilojoules/mole; 2-methylbutane, 3528·03 ± 0·62 international kilojoules/mole. Converted into kilocalories by means of the generally accepted factor 1/4·1833, these values become 840·61 ± 0·23 and 843·36 ± 0·15, respectively.

Combining these values with those previously reported for *n*-pentane shows that in the gaseous state at 25° C. and 1 atm. the energy content of *n*-pentane is greater than that of tetramethylmethane by 19·59 ± 1·29 kilojoules or 4·68 ± 0·31 kilocalories/mole, and greater than that of 2-methylbutane by 8·09 ± 1·08 kilojoules or 1·93 ± 0·26 kilocalories/mole. D. L. S.

918. Type Analysis of High Boiling Hydrocarbon Oils. A. V. Grosse. *Refiner*, 1939, **18** (4), 149.—The author discusses the theory underlying the analysis of paraffinic and mono- and poly-naphthenic oils. The specific refraction method of Waterman and his co-workers is examined, and it is shown that the hydrogen/carbon ratio can be used with greater theoretical justification, accuracy, and simplicity in the determination of the number of rings per molecule in saturated oils than the specific refraction. It is considered that the percentage of paraffinic or naphthenic hydrocarbons present in a saturated oil cannot be determined by existing methods. A naphthenicity index and an aromaticity index are proposed. The former is defined as the difference between the hydrogen/carbon ratio of the oil and that of the paraffin having the same number of carbon atoms, multiplied by 100. G. R. N.

919. High-Octane *iso*Paraffinic Fuels. S. F. Birch, A. E. Dunstan, F. A. Fidler, F. B. Pim and T. Tait. *Industr. Engng Chem.*, 1939, **31** (7), 884.—In the presence of concentrated sulphuric acid the lower olefins, with the exception of ethylene, react with considerable ease with *iso*butane to yield products consisting essentially of *iso*paraffins. The reaction carried out in the liquid phase at temperatures in the range −10° to 30° C., is exothermic, the heat of reaction being of the order of 500–600 B.Th.U.'s/lb. of unsaturated C_4 hydrocarbon reacting. From the reaction product a fully saturated fraction (boiling from 27° to 185° C.) may be isolated by distillation, consisting almost entirely of *iso*paraffins from *iso*pentane to *iso*decanes and higher. The high octane rating, roughly 90+ of this fraction, coupled with its low sulphur content, renders it an excellent material for 100-octane aviation gasoline. Propylene, *iso*butene, 1- and 2-butene, trimethylethylene, and the lower polymerides of *iso*butene, di- and tri-*iso*butene all react smoothly with *iso*butane to give good yields of saturated products. Of the paraffins used in the reaction, *iso*butane, *iso*pentane, and *iso*hexane (2-methylpentane) reacted smoothly, although the octane number of the saturated product decreased rapidly with increasing length in carbon chain of the *iso*paraffin used in the reaction. By repeated fractionation, indications were obtained of the presence of 2 : 4 and 2 : 5-dimethylhexanes and 2 : 3 : 4- and 2 : 3 : 3-trimethylpentanes, and further small quantities of *iso*pentane, 2 : 3-dimethylpentane, 2 : 3- and 2 : 4-dimethylpentanes and 2 : 2 : 5-trimethylhexane have been isolated from the reaction mixture in the poly*iso*butene–*iso*butane reaction.

The effect of varying the reaction conditions, upon the yield and nature of the product is outlined. It has been demonstrated that the unsaturated four-carbon fraction obtainable from normal cracking operations is a satisfactory starting material for commercial operation when used with an *iso*butane concentrate from natural gasoline stabilization. The acid consumption and the heat evolved in the exothermic reaction are also discussed. H. E. T.

920. Attempts to Prepare the Methylene Radicle by Thermal Decomposition of Hydrocarbons. F. O. Rice. *J. Amer. chem. Soc.*, 1939, **61**, 213.—An attempt to prepare methylene by passage of methane or other hydrocarbons over heated filaments resulted in the production of a large enough supply of dimethyl telluride from Te mirrors to identify it (m. p. — 19·5°). The attempt to prepare ketene by passing a mixture of carbon monoxide and methane or other hydrocarbons over a hot filament was unsuccessful. The conclusion is that trivalent carbon radicles are the primary products of organic dissociations, and even in the few cases in which methylene is the primary product it passes readily into the trivalent state. R. D. S.

921. Kinetics of Decomposition of *n*-Butane. I.—Normal Decomposition. L. S. Echols and R. N. Pease. *J. Amer. chem. Soc.*, 1939, **61**, 208–212.—This is the first of a series of papers on this subject, the investigation being prompted by suspected complications in the pyrolyses of propane and the butanes, which, from flow experiments at 1 atm., appear to be homogeneous dissociations of the first order. It was found that pure nitric oxide inhibits *n*-butane decomposition, an effect that is partly transient, thus confirming the belief that the mechanism is a radical chain reaction. Later, it was found that propylene, a reaction product, also effects transient inhibition. Kinetic data were obtained from pressure measurements at constant volume. The normal decomposition was investigated between 480 and 535° C. and from 100 to 600 mm. pressure, and it was found that the reaction was not strictly of the first order; initially, an order of 5–6 is required, and comparison of times to 10% decomposition for different initial pressures indicated an order of about 1·3. It was demonstrated that the complexity of the reaction was not due to impurity in the butane employed. A semi-empirical equation is given to fit the data. R. D. S.

922. Bromination of Trimethylethylene. (1) W. E. Vaughan and F. F. Rust. *J. Amer. chem. Soc.*, 1939, **61**, 215–216. (2) J. B. Conn, G. B. Kistiakowsky and E. A. Smith. *Ibid.*, 1939, **61**, 216–217.—When 1 vol. chlorine and 2 vols. *iso*butene reacted together at 70°, Vaughan and Rust found 99% consumption of chlorine, 93% by substitution; but when these gases were passed together over granular calcium chloride at 109° the chlorine completely disappeared, 19% of it producing hydrogen chloride by substitution. These authors, therefore, cast doubts on the validity of the figure for the heat of catalytic addition of bromine to trimethylethylene obtained by Conn, Kistiakowsky and Smith (*J. Amer. chem. Soc.*, 1938, **60**, 2764–2771; *J. Instn Petrol.*, Abstr. No. 310, 1939), as the latter tested the effluent gas in their experiments for unreacted halogen and for substitution by test-papers and relied on refractive indices as criteria of the purity of the products, there being no literature value for trimethylethylene dibromide. By such tests the last-named authors detected substitution occurring during dynamic bromination of *iso*butene and *cyclo*hexane, although trimethylethylene seemed to react cleanly. Vaughan and Rust, in an attempt to confirm this, passed bromine, trimethylethylene, nitrogen, and carbon dioxide over calcium bromide–asbestos at 82°. Test-papers showed no unreacted bromine or acid, and the catalyst was found to be uncontaminated with liquid condensate. After topping of the product to remove unreacted olefin the residue was fractionated. This showed definitely that the product of reaction is a mixture, and the difficulty of avoiding substitution reactions when halogenating tertiary olefins.

In reply, Conn, Kistiakowsky and Smith admit the correctness of the criticism, but believe that the error thus introduced is rather small, as the catalyst they used was inactive owing to previous extended use, so that the secondary reactions described above may easily have been less pronounced in their experiments. Even if the yield of monobromides was considerable, they argue that this could not seriously have affected their thermal data, and so the original estimate of the over-all error is adequate. R. D. S.

923. Cracking of Kerosine as Function of Pressure and Temperature. C. Otin and S. Savencu. *Monit. Pétr. roum.*, 1939, **40** (10), 635–639; (11), 705–708.—A kerosine was heated for varying periods of time at different temperatures and pressures, alone and with catalysts, and after each treatment the properties of the product were compared with the original. First, it was heated alone for 2, 4, 6, 8, and 10 hrs. (1) at 170° C. and atmospheric pressure, (2) at 115° C. and 10 kg./cm.² pressure, (3) to an initial temperature of 240° C. at 20 kg./cm.² pressure. On examination of the physical and chemical constants of the products, including distillation, the authors concluded that the only factor favourably influencing the yield of light products was temperature. Next, the kerosine was heated to various temperatures for 2 hrs. at normal, at 10, and at 20 kg./cm.² pressure with 5% concentration of finely divided, chemically pure metals, oxides, chlorides, and sulphates. Except for chlorides, these had only a feeble catalytic effect on the cracking. The chlorides of magnesium and iron had a noticeable influence, but aluminium chloride had a most pronounced effect. To investigate the latter more fully, the time was also varied to 4, 6, 8, and 10 hrs. with 5% aluminium chloride and at pressures of 1, 10, and 20 kg./cm.²; and 1% and 10% concentrations of aluminium chloride were used at the same pressures for 2 hrs. In all these experiments increased time and pressure tended to increase the yield of light bodies, but the effects of temperature and increase in proportion of catalyst were the most profound. Of other catalysts tried only aluminium bromide gave results comparable to aluminium chloride.

The authors' conclusions are that only temperature has a favourable effect on cracking, particularly if no catalyst or a badly chosen catalyst be employed; but if the catalyst is correctly chosen, then time and pressure may also have a marked effect.

R. D. S.

924. Comparative Efficiency of Catalysts in Polymerising Unsaturated Hydrocarbon Gases under Pressure. D. Rudkovskii, G. Shevtsova and G. Pemeller. *Petrol. Engr*, April 1939, **10** (7), 65.—Laboratory-scale experiments for comparing the efficiency of catalysts in the polymerization of olefines are described. Of the catalysts examined, clay had a poor catalytic action and was rapidly poisoned. Molten zinc chloride was highly active, but was quickly poisoned by solution of polymerization products. Zinc chloride deposited on chamotte carrier proved a very effective catalyst, but rapidly deteriorated owing to the deposition of coke. Phosphoric acid on a solid carrier was the most efficient of the catalysts examined. Its efficiency is explained by the assumption that intermediate phosphoric esters are formed which soon decompose with regeneration of the acid and growth of the olefine molecules. Of the three phosphoric acids the pyro-acid was the most effective. R. J. E.

925. Industrial Use of the Alkaline Waste Liquors Derived from Refining Cracked Naphthas. C. N. Dacu. *Monit. Pétr. roum.*, 1939, **40**, 151.—Mercaptans and phenolic compounds were extracted (on a laboratory scale), by methods which lend themselves readily to industrial applications, from alkaline solutions derived from treating cracked naphthas.

By entrainment with steam at about 100–110° C. approximately 2·5% mercaptans were obtained, boiling within the range 120–250° C.

Subsequently, after obtaining the mercaptans, the phenols were extracted from the same solution by the following methods :—

(*a*) Entrainment with superheated steam.
(*b*) Treatment with sulphuric acid of various concentrations.
(*c*) Treatment with hydrochloric acid of various concentrations.
(*d*) Treatment with carbon dioxide.

Of the above methods (*b*) gave the highest yields, with about 27% of phenols on the original solution. The optimum sulphuric-acid concentration, in respect to yields and resulting phenol quality, was found to be 20%. Method (*d*), however, is more likely to find application in refinery practice (about 19% phenol yield) because of the availability of CO_2 in the stack gases. G. S.

926. Aromatisation of some Homologues of *cyclo*Pentane and Paraffins. B. A. Kazanski and A. F. Plate. *Nat. Petrol. News*, 5.4.39, **31** (14), R. 134.—It has been shown that

*cyclo*pentane and its simplest homologues are hydrogenated in the presence of platinized carbon in an atmosphere of hydrogen at a temperature of 300–310° C. The higher homologues such as normal and secondary butyl*cyclo*pentane and *iso*amyl-*cyclo*pentane suffer not only hydrogenation, but a measure of aromatization. In an atmosphere of CO_2 or nitrogen, yields of aromatics as high as 35% have been obtained. Is it assumed that the side-chain is cyclicized, the hydrindane formed rupturing in the presence of excess hydrogen, to form *O*-ethyltoluene. *N*-octane in an atmosphere of nitrogen yields 10% of aromatics, the permanganate oxidation products of which are benzoic and phthalic acids. Methyl-, ethyl-, and propyl-*cyclo*pentane do not show this reaction. H. G.

927. Preparation of Low-Temperature Hydrogenation Catalysts. B. Dudley Sully. *Chem. & Ind.*, 1939, **58**, 282–284.—The disadvantages of the Raney catalyst have led to the development of a nickel catalyst by other means. The catalyst has been developed primarily for the liquid-phase hydrogenation of crotonaldehyde to butyl alcohol. Nickel carbonate is precipitated from a solution of the sulphate by the addition of sodium carbonate. The nickel carbonate is readily reduced at 310° C.

The colloid mill has been adapted for the preparation of mixed copper and nickel catalysts, the carbonates being passed through the mill in a mother-liquor of sodium sulphate.

The activity of the catalysts is assessed by testing the rate of hydrogenation of *iso*-pulegol to menthol. A suitably active catalyst will complete 80% of this hydrogenation in 40 mins. under the conditions of test. T. C. G. T.

928. Inflammation of Mixtures of Air with Diethyl Ether and with Various Hydrocarbons at Reduced Pressures: Green Flames. M. S. Hsieh and D. T. A. Townend. *J. chem. Soc.*, February 1939, 332–337.—This investigation was carried out to examine more fully the nature of "green flames" which certain mixtures of diethyl ether and air produce at low pressures, the nature of their visible emission and the inflammable ranges of ether–air and hydrocarbon–air mixtures. The latter were determined in a horizontally-mounted glass tube electrically heated with asbestos-covered nichrome wire. The normal flames were initiated by a high-tension spark. As the pressure was reduced the limits of inflammability approached one another and green flames were produced, being most intense at the critical pressure where the higher and lower limits coincide (90 mm. at 20° C.; 80 mm. at 100° C.; 78 mm. at 150° C., corresponding to 5% ether in air). Similar phenomena were observed with *n*-hexane–air, propane–air, and methane–air mixtures. The latter series give three pressure limits of inflammability within a very narrow range of mixtures near 12·8% methane in air. It is inferred that the emission of green flames is common to all hydrocarbons.

The green flames are attributable to the Swan bands arising from C_2 molecules which emit at 4381 and 4737 Å in the green region of the spectrum, and are favourably influenced by deficiency of oxygen and by reduced pressure. The C_2 molecules are present in an excited state at temperatures and/or pressures below which there is any evidence of aggregated carbon, but how they arise is speculative. R. D. S.

929. Mechanism by which "Cool" Flames may give rise to "Normal" Flames. Part I. Inflammable Ranges of Ether–Air Mixtures in Closed Vessels. M. S. Hsieh and D. T. A. Townend. *J. chem. Soc.*, February 1939, 337–340.—The ignition of certain hydrocarbons is brought about in the temperature range 300–400° by a two-stage process, the normal flame occurring after the passage of a cool flame and after a definite short time interval. If the pressure is sufficiently high, the higher hydrocarbons ignite in the cool-flame range by a one-stage process, ignition being almost as violent as detonation; thus correlating engine-knock with the probable spontaneous ignition of the unburnt charge ahead of the flame. It was fairly well established that spontaneous ignition arising from prior cool-flame formation is the same, whether the cool flames are initiated by hot-wire in the cold or by heating. At the minimum ignition pressure the inflammability range was greater, the higher the temperature. The minimum pressures for normal ignitions were much higher than for cool flames. The authors consider that the initiation of normal flames in the cool-flame range at a critical pressure is a sudden development of pressure greater than that which can be

ascribed to cool flames. When the limiting pressure for normal flames in the cool-flame range was reached, ignition occurred some distance after the cool flame passed down the tube and the normal flame travelled forward to, and replaced, the cool flame. The authors believe that the superposition of the normal-flame range on the cool-flame range arises by a similar process for artificial as for spontaneous ignition.
R. D. S.

930. Mechanism by which "Cool" Flames may give rise to "Normal" Flames. Part II. Inflammable Ranges of Higher Paraffin Hydrocarbons in Air: Establishment of "Cool" Flame Ranges at Ordinary Temperatures and High Pressures. M. S. Hsieh and D. T. A. Townend. *J. chem. Soc.*, February 1939, 341–345.—The general tendency of increasing pressure on mixtures of combustible gases with air and oxygen is to widen the limits of inflammability, chiefly at the upper limit. Previous work on higher paraffin hydrocarbons showed also that not only was the widening progressively greater as the series was ascended, but in each case, on the attainment of an adequate pressure, which decreased in the same order, it became accentuated abruptly. The higher paraffins behave in a similar manner to ether in spontaneous ignition experiments in the cool-flame range; hence, from the relationship between spontaneous ignition and inflammability, observed in the preceding paper, the corresponding cool-flame inflammation ranges ought to exist with higher paraffins at ordinary temperatures in a way similar to those known to exist with ether–air mixtures. Further, owing to (*a*) minimum pressures and (*b*) time-lags for spontaneously developed cool flames, both being greater for hydrocarbons than for ether–air mixtures, and to (*a*) and (*b*) decreasing as the paraffin series is ascended, the cool-flame ranges should be located at progressively decreasing initial pressures in the same order. All these predictions were confirmed in re-determinations of the limits of inflammability of hexane, butane, and propane: at 100° C. the cool-flame ranges were: above 5 atm., above 9 atm., above 12 atm., respectively.
R. D. S.

931. Mechanism of Additions to the Double Bond. Part VI. Kinetics of Gaseous Associations. G. A. Benford and A. Wasserman. *J. chem. Soc.*, March 1939, 362–367.—The velocity coefficient (k) of a bimolecular reaction can be expressed in terms of a steric factor (P) and a collision frequency (Z) so that $k = A_e^{-E/RT} = PZ_e^{-E/RT}$, where E is the activation energy. For gaseous reactions involving atoms or diatomic molecules P = about 1 and $A = Z$ approximately, but in the diene synthesis in the gaseous phase P is probably < 1. Experiments are described in which gaseous *endo*-dic*yclo*pentadiene was formed from the association of gaseous *cyclo*pentadiene. A study of the kinetics of the reaction between 79° and 150° at initial pressures between 154 and 735 mm. confirms the impression that P is much smaller than unity. A qualitative explanation for this is tendered.
R. D. S.

932. Mechanism of Additions to the Double Bond. Part VII. Chemical Equilibrium in Solution and in the Gaseous State. G. A. Benford and A. Wasserman. *J. chem. Soc.*, March 1939, 367–371.—The constants of two association equilibria (*a*) $C_5H_6 + H_2 \rightleftharpoons C_5H_8$; (*b*) $2C_5H_6 \rightleftharpoons C_{10}H_{12}$ (dic*yclo*pentadiene) were compared in the gas phase and in solution by using van't Hoff's equation involving the solubilities of the reactants and of the products. The reactants and the products of equilibrium (*a*) possessed numerically smaller heats of solution and larger statistical weight of the condensed molecules than the molecules of association (*b*). It was shown that the heat changes of both gaseous associations are not much altered by the presence of the solvent, and also that the statistical weight of ethane is of the same order of magnitude in both states, but that the statistical weight of dic*yclo*pentadiene is somewhat larger in solution than in the gas phase.
R. D. S.

933. Mechanism of Additions to the Double Bond. Part VIII. Equilibrium of Gaseous Associations. B. S. Khambata and A. Wasserman. *J. chem. Soc.*, March 1939, 371–375.—The non-exponential factor (a function of the translational, rotational, and vibrational partition functions) of the equilibrium constants of the association of gaseous *cyclo*pentadiene to gaseous dic*yclo*pentadiene was determined from the kinetics

of the formation and decomposition of di*cyclo*pentadiene in B.P. paraffin. The kinetic measurements were carried out between — 1° C. and 175° C. and the solubilities between 27° C. and 111° C. The translational, rotational, and vibrational partition functions were calculated for both reactant and product, and it was deduced that at 80° C. the vibrational partition function of di*cyclo*pentadiene is at least 500 times the square of that of *cyclo*pentadiene. Qualitative confirmation of this calculation is adduced by consideration of models. R. D. S.

934. Mechanism of Additions to the Double Bond. Part IX. Kinetics of the Association of *cyclo*Pentadiene in Carbon Tetrachloride Solution and in the Pure Liquid State. G. A. Benford, H. Kaufmann, B. S. Khambata, and A. Wasserman. *J. chem. Soc.*, March 1939, 381–387.—The study of the mechanism of the association of *cyclo*pentadiene in carbon tetrachloride solution showed that the kinetics of the reaction were not measurably influenced by the presence of oxygen, peroxides, or acetonitrile, and that the reaction is of the second order at all temperatures. In the pure liquid state, however, the second-order velocity coefficients are constant at — 2° C., but they increase at temperatures up to 39·4° C. This is considered due to the fact that at the beginning of the run the "solvent" is *cyclo*pentadiene, but at the end it is di*cyclo*pentadiene. The mechanism of the association is bimolecular in both carbon tetrachloride and the pure liquid state. R. D. S.

935. Mechanism of Cracking. Part 1. Kinetics of Inverse Diene Synthesis in Solution and in the Pure Liquid State. B. S. Khambata and A. Wasserman. *J. chem. Soc.*, March 1939, 375–381.—The kinetics of the decomposition of *cyclo*pentadienebenzoquinone and of *cyclo*pentadiene-α-naphthaquinone were measured in benzene solution and the cracking of di*cyclo*pentadiene was studied in B.P. paraffin solution and in the pure liquid state. The experiments were carried out at atmospheric pressure between 49° C. and 175° C. In solution all these inverse diene syntheses are of the first order. No induction period occurred in the decomposition of *cyclo*pentadiene, nor did peroxidic intermediate compounds, glass powder, Hg, PbO_2, MoS_2, and SnS affect the rate, indicating that the decomposition is not a chain reaction. The non-exponential factors of the velocity coefficients are of the order of magnitude of interatomic vibration frequencies, and it was concluded that the mechanism of the inverse diene synthesis is unimolecular in solution and in the pure liquid state. R. D. S.

936. Physics of Flames and Explosions of Gases. B. Lewis and G. von Elbe. *J. Appl. Phys.*, 1939, **10** (6), 344.—This paper presents a concise summary of our present knowledge. The subjects dealt with include ignition, flame propagation, detonation, flames resulting from the diffusion of one of the reactant gases into the other, and the state of the burnt gas. P. D.

937. "Transformation" and Detonation. O. Herstad. *Oel u. Kohle*, 1939, **15**, 385–388.—In the ordinary state, a drop of liquid on a hot surface is in contact with the surface on one side, and with a mixture of air and vapour on the other; in the "transformed" state the drop of liquid is separated from the surface by a thin film of vapour. (For earlier work on this subject see Abstracts Nos. 836 and 1423 of 1938.)

The author claims that his experimental work has shown that for a complete solution of the problem, knocking must be considered in relation to the transformation properties of the fuel. In investigating the ignition properties of fuels, the author condemns the drop method of analysis, since, owing to variations in physical properties between different liquids, drops from the same orifice will have different weights and volumes, and different rates of formation. Consequently, as the test apparatus has a combustion space of fixed dimensions, the same ratio of fuel vapour to air will not be obtained on adding drops of different liquids, and strictly comparable results for the ignition temperatures will not be obtained.

A diagram is given of four typical S.I.T. curves as obtained on the "Zundwertprüfer," one of which exhibits the "Zundlücke" first described by Jentzsch. The explanation of this phenomenon by Zerbe and Eckert is refuted and replaced by one based on the transformation concept. The author shows that the temperature at which

transformation sets in in the case of gas oils may vary by 100° C. according as the surface on which the drops impinge is polished (300° C.) or rough (400° C.). Citing this as proof of the number of apparatus constants necessarily inherent in the Zundwertprüfer, the author, while agreeing that the test engine is not ideal for the determination of ignition qualities, prefers the results obtained from it to those obtained with the former apparatus, although he finds it of interest in investigating transformation. T. T. D.

938. Phase Equilibria in Hydrocarbon Systems: Latent Heat of Vaporization of Propane and *n*-Pentane. B. H. Sage, H. D. Evans and W. N. Lacey. *Industr. Engng Chem.*, 1939, **31** (6), 763.—The latent heat was determined experimentally over the temperature ranges 100–170° F. (propane) and 80–200° F. (*n*-pentane). The results are compared with experimental and calculated values obtained from the literature. P. D.

939. Separation Processes. Point Transformations of y versus x diagrams. M. Randall and B. Longtin. *Industr. Engng Chem.*, 1939, **31** (7), 908.—Methods are given for transforming the x versus y equilibrium diagram to give $(y - x)$ versus y, $(y - x)$ versus x, $(y - x)$ versus $(y + x)$ and $(y - x)$ versus $(2x - y)$. The usefulness of some of these, particularly the $(y - x)$ versus x diagram when using the McCabe and Thiele method of designing fractionating columns for volatility ratios near unity, is emphasized. P. D.

940. Enthalpy-Concentration Charts from Vapour-pressure Data. W. Haltenberger, Jr. *Industr. Engng Chem.*, 1939, **31** (6), 783.—The enthalpy-concentration chart for a liquid solution may be constructed from a knowledge of heat capacities at one concentration and heats of dilution over the concentration range. Experimental data for the latter are scarce, but calculated values may be obtained from vapour-pressure data. The method is described and illustrated by the construction of the enthalpy-concentration chart for sodium hydroxide solution up to 50% by weight of NaOH. P. D.

See also abstract No. 958.

Analysis and Testing.

941. Testing of Used Motor Lubricating Oils by A.S.T.M. Methods. G. Blank. *Oel u. Kohle*, 1939, **15**, 341–346.—The following A.S.T.M. methods of testing used oils are described and discussed: (i) Material Insoluble in A.S.T.M. Naphtha and Chloroform; (ii) Ash; (iii) Conradson Carbon Residue; (iv) Water Content; (v) Deposits; (vi) Diluent Content; (vii) Viscosity; (viii) Neutralization Number; (ix) Saponification Number; (x) Specific Gravity; (xi) Flash Point. T. T. D.

942. Contamination of Lubricating Oil by Water. M. G. Damany. *II^me Congrès Mond. Pétrole*, **2** (Sect. 2), 791–795.—The author describes an apparatus designed for use on board ship for the detection of water in lubricating oil. The apparatus consists of an electrical condenser through which the oil is pumped and a valve circuit for indicating variation in capacity of the condenser due to the presence of water. R. R. F.

943. Miniature Grease Penetrometer. G. Kaufman, W. J. Finn and R. J. Harrington. *Industr. Engng Chem., Anal.*, 1939, **11** (2), 108.—Because of the relatively large amount of sample required, the A.S.T.M. grease penetrometer is unsuitable for testing the consistency of small amounts such as used grease from ball or roller bearings. A miniature penetrometer was designed to determine the consistency of samples weighing about 3–5 gm. The instrument is described, and follows the lines of the official tester, the cone and plunger being made of aluminium and having a total weight of 20 gm. Data obtained on both instruments indicated that the relationship, if any, varied with the texture of the grease, the particular soap used, or the viscosity of the mineral oil. It was concluded that the miniature instrument should be regarded as a valuable adjunct to the official tester. G. R. N.

944. Mineral Oil Deterioration. A. G. Assaf and E. K. Gladding. *Industr. Engng Chem., Anal.*, 1939, **11** (3), 164.—Oxidized petroleum oils such as used insulating oils have been studied by the Grignard reagent (methylmagnesiumiodide) method of Larsen. The present paper describes improvements in the apparatus and procedure. It also gives results which show the accuracy of the quantitative determination, by the Grignard reagent of the types of compounds—ketones, esters, and peroxides—which may occur in oxidized mineral oils. G. R. N.

945. Determination of Undissolved Sludge in Used Oils. H. Levin and C. C. Towne. *Industr. Engng Chem., Anal.*, 1939, **11** (4), 181.—After examining various solvents the authors find that commercial pentane is the most suitable for separating undissolved sludge from used or oxidized motor oils. The procedure is as follows : separate 10-gm. amounts of the sample before and after percolation through absorbent cotton (at 60–75° C.) are agitated in conical flasks with 100 ml. pentane. After standing overnight the deposited sludge is filtered off through a Gooch crucible and washed with 100 ml. pentane, then dried at 110° C. for 1 hr. From the difference in the weights of insoluble matter the undissolved sludge is calculated as follows :—

$$C = 1000\left[A - \left(B\,\frac{10 - A}{10 - B}\right)\right]$$

where A = sludge undissolved by pentane, original sample (gm./10 gm.).
B = sludge undissolved by pentane, clarified sample (gm./10 gm.).
C = undissolved sludge (mg./10 gm.).

When A is low (0·1) for practical purposes $C = 1000(A - B)$.

The method gives results reproducible within 5% on the sludge basis when the sludge content is high, but duplicate tests within 4 mgm./10 gm. are considered its limit of reproducibility. G. R. N.

946. Determination of Dissolved Sludge in Used Oils. F. W. Hall, H. Levin and W. A. McMillan. *Industr. Engng Chem., Anal.*, 1939, **11** (4), 183.—The criterion set up for characterizing dissolved sludge in used oils was the material insoluble in liquid propane, using as the sample the oil obtained by percolation of the used oil through absorbent cotton. A suitable laboratory apparatus is described in which 4 gm. of the clarified sample are contacted with 64 ml. liquid propane, then washed with this solvent in a closed system under pressure. After removal of the propane the insoluble material is dissolved in warm benzol, the resulting solution being filtered into a small beaker, then evaporated on a steam-bath. The insoluble material is finally dried at 110° C. for 1 hr. The method has yielded results reproducible within 5% on samples containing large amounts of dissolved sludge, and within 5 mgm./10 gm. on samples containing small amounts. Results have shown that frequently the dissolved sludge is greater than the undissolved sludge (cf. preceding abstract). G. R. N.

947. Thermostatic Bath for Low Temperature Viscosity Determinations. E. L. Baldeschwieler and L. Z. Wilcox. *Industr. Engng Chem., Anal.*, 1939, **11** (4), 221.—A thermostat, which can be operated at from $-10°$ C. to $-60°$ C. with a temperature control of $\pm$ 0·03° C., is described. It consists of a cooling-coil and bath, a Hoeppler ultra-thermostat, and a Dewar type flask in which a Ubbelohde viscometer is set up. Alcohol–water mixture is used as the recirculating fluid, whilst *iso*propyl alcohol plus solid carbon dioxide is the refrigerant. G. R. N.

948. Apparatus for Microanalysis of Gas. C. H. Prescott, Jr., and J. Morrison. *Industr. Engng Chem., Anal.*, 1939, **11** (4), 230.—This article describes modern refinements of apparatus and technique for the rapid analysis of minute amounts of gas. On samples of 5–25 cu. mm. at normal temperature and pressure, analyses may be made with errors for each component within 2% of the total sample. The errors are within 5% on quantities of gas as small as the proverbial limit of 1 cu. mm. The methods described are available for the gases, water, carbon dioxide, hydrogen, carbon monoxide, and oxygen or methane. One hour is required for a complete general analysis. Under

special conditions the least detectable quantity of a component may be pushed to a limit of 0·025 cu. mm. equivalent to the carbon monoxide in 1 sq. cm. of a monomolecular film. G. R. N.

940. Composition of High-Solvency Hydrocarbon Thinners. E. H. McArdle and others. *Industr. Engng Chem., Anal.*, 1939, **11** (5), 248.—Data gathered by ten laboratories working in six co-operating groups show that the refractive index–sulphuric acid extraction method for determining the aromaticity of commercial high-solvency hydrocarbon thinners, the evaporation rates of which are similar to that of toluene, and which are substantially olefin free, provides results which are reasonably accurate, as shown by comparison with synthetic blends, and can be duplicated by several stations with a precision of $\pm$ 0·5%. Although the method does not determine the naphthene or paraffin content with equal accuracy, the relatively greater importance of aromaticity is demonstrated by a reasonably good concordance in the viscosities of solutions of film-forming materials in the commercial thinners and their synthetic matches. The above method is not recommended for the proximate analysis of low-solvency thinners. A nomograph connecting composition, average boiling point, and refractive index for an aromatic free naphtha is given. G. R. N.

950. Measuring Oxidation of Lubricants. V. R. Damerell. *Industr. Engng Chem., Anal.*, 1939, **11** (5), 265.—A simple test for measuring the thickening produced in hypoid lubricants by heat treatment is described. It consists of noting the time of flow of a 5-gm. sample of the oil placed in a cylindrical glass crystallizing dish, 80 mm. diameter, 40 mm. deep, when the latter is first placed on one side, set upright, then placed on the other side. Two horizontal lines in ink on the sides of the dish determine the extent of the flow to be recorded. Four advantages for this method are claimed, viz: (1) the change in flow time of the entire sample is determined, showing in a simple manner the tendency of the lubricant to thicken in practice; (2) the method is time-saving; (3) the apparatus is simple; and (4) the sample may be reheated as many times as desired, giving a curve (flow time or percentage increase in flow time *v.* time of heating) instead of a single result. G. R. N.

951. Stedman Packing for Close Fractionation. L. B. Bragg. *Industr. Engng Chem., Anal.*, 1939, **11** (5), 283.—The conical type of Stedman packing is made of wire cloth which has been embossed and trimmed into flat, truncated conical discs. A semi-circular hole is cut out of one side of the cone and extends about two-thirds of the distance from the edge of the cone to the flat in the centre. The discs are welded together alternately back to back and edge to edge to form a regular series of cells with the holes, which serve as passages for the vapour located alternately on opposite sides of the section of packing. In operation the liquid flows along the screen and seals the opening of the mesh, then out towards the walls of the column on a cone that is concave downward, then back to the centre of the column on a cone that is concave upward, which is welded to the first cone at the outer edge. The lower cone is welded to another still lower cone at the centre, and the liquid flows through the mesh at the point of junction. The vapour enters the space between two cones which are welded around the outer edges, through the vapour hole in the lowest cone. It then flows through the space between these two cones, practically at right angles to the axis of the column and out through the vapour opening in the upper cone of the pair. The vapour then divides and flows around the point where two cones are joined back to back and across to the side of the column where it first entered the packing. Thus there is continual mixing and separation of liquid and vapour, so that channelling is negligible. This packing was tested (in three sizes) using benzene–ethylene dichloride as the binary mixture, and it is shown that at comparable vapour velocities it is superior to all other types of packing. G. R. N.

952. Glass Helices for Fractionating Columns. R. W. Price and W. C. McDermott. *Industr. Engng Chem., Anal.*, 1939, **11** (5), 289.—Glass helices are frequently used at the present time as packing for laboratory fractionators. Suitable methods for their manufacture in the laboratory either require considerable skill or special equipment. The authors describe a straightforward procedure in which only the ordinary tools of the laboratory are required. G. R. N.

953. Determination of Lead Tetraethyl in Gasoline. G. Calingaert and C. M. Gambrill. *Industr. Engng Chem., Anal.*, 1939, **11** (6), 324.—50 ml. of the gasoline, 50 ml. of a straight-run kerosine, and 50 ml. of concentrated hydrochloric acid are refluxed in a special glass apparatus for 30 mins. After cooling, the acid is drained off, then 50 ml. water are added to the gasoline–kerosine and refluxed for 5 mins. After cooling the water is separated and added to the acid. The aqueous solution so obtained is evaporated to dryness. The lead chloride is treated with nitric acid until a white salt is produced. It is next dissolved in dilute nitric acid and the lead is determined either gravimetrically as the chromate or volumetrically as the molybdate. It was found that this method yields results with a mean error of only — 0·012 ml. $PbEt_4$ per gallon of gasoline, as against — 0·054 for the bromination method, the improvement being particularly noticeable in the case of cracked gasolines. G. R. N.

954. Traces of Copper in Gasoline Determined by New Test. G. H. Short and W. A. Schulze. *Nat. Petrol. News*, 19.4.39, **31** (16), R. 162.—The test is quasi-quantitative, and depends on the formation of a copper complex of diphenylthiocarbazone, and hence the gradual change in colour of the reagent, which, in solution, is green. The reagent is prepared by dissolving diphenylthiocarbazone in C.P. benzene to obtain a concentration of 2 mgm. per 100 ml. solution. 100 ml. of the gasoline are filtered through paper into a glass vessel and 1 ml. of the reagent is added and the mixture stirred gently. The time for the colour to change from the original vivid green to yellow is determined in minutes. The rate of colour change decreases with increasing amounts of copper present. Precautions to be taken to avoid the vitiation of results are :—

(*a*) The test must be carried out in the minimum of light compatible with proper observation.

(*b*) Alkaline solutions, mineral acids, mercaptans, and metals other than Cu affect the rate of colour change.

(*c*) Water, if present, and especially if of p_H greater than 7, accelerates the rate of colour change.

(*d*) Contact with air and the inclusion of air in the gasoline by shaking or too vigorous stirring should be minimized.

(*e*) The test should be carried out at a reasonably constant temperature.

H. G.

See also Abstracts Nos. 971, 792, 973 and 978.

Motor Fuels.

955. Patents on Motor Spirit. Standard Oil Development Co. E.P. 504,470, 26.4.39. Appl. 3.11.37. Improvement of motor spirit by adding 5% or more of a normally liquid ether which is miscible with the hydrocarbon, having the formula ROR′, in which R is a branched aliphatic hydrocarbon group and R′ is an ethyl group, *e.g.*, tertiary butyl ethyl ether and a small amount of lead tetraethyl.

Standard Oil Development Co. E.P. 504,837, 2.5.39. Appl. 3.11.37. Method for the improvement of motor fuel as described in E.P. 504,470 in which tertiary butyl secondary butyl ether is added.

I. Lovens. E.P. 506,230, 24.5.39. Appl. 23.4.38. Preparation of a product to be added to liquid fuels for use in internal combustion engines to increase their efficiency, by treating a vegetable non-drying oil such as olive oil, dissolved in white spirit, benzol, toluol, etc., with a quantity of oxygen and of hydrogen.

N.V. de Bataafsche Petroleum Mij. E.P. 506,574, 31.5.39. Appl. 15.10.38. Removal of mercaptans from motor spirit by means of aqueous caustic alkali containing di-amino alcohol.

D. L. Yabroff and E. R. White. U.S.P. 2,156,577, 2.5.39. Appl. 8.2.37. Removal of mercaptans from petroleum distillates by means of an aqueous solution of alkaline metal hydroxide containing a substantial amount of a dissolved salt of aminocarboxylic acid having 4–7 C atoms.

E. D. Sutton. U.S.P. 2,157,223, 9.5.39. Appl. 17.6.35. Sweetening hydrocarbon oil by mixing it with an aqueous alkaline plumbite solution containing an oil-insoluble soap in the solution.

M. Mueller-Conradi and R. Uloth. U.S.P. 2,159,175, 23.5.39. Appl. 24.1.35. Process of dividing liquid hydrocarbon mixtures boiling within the b. pt. ranges of benzine into fractions of different octane values by treatment with acetonitrile.

H. E. Bode. U.S.P. 2,160,116, 30.5.39. Appl. 16.8.37. Method of treating naphtha to remove mercaptans by mixing 100 parts of naphtha containing 1% of mercaptan, 2 parts of dextrose, and 2 parts of HCl (sp. gr. 1·19), to precipitate glucose mercaptan.

W. J. D. van Dijck. U.S.P. 2,160,607, 30.5.39. Appl. 1.7.35. Refining of cracked distillates to remove sulphur compounds by solvent extraction with thiopene aldehyde or cyanothiophene.

D. L. Yabroff and E. R. White. U.S.P. 2,160,632, 30.5.39. Appl. 7.5.37. Separation of mercaptans from hydrocarbon distillates by treatment with an aqueous solution of ethylene glycol containing not less than 25% of water. The solution is saturated with an alkali metal hydroxide, the amount of glycol being sufficient to prevent salting out of the alkali metal mercaptides from the solution. W. S. E. C.

See also Abstracts Nos. 953, 954.

Gas, Diesel and Fuel Oils.

956. High-speed Diesel Fuels Less Acute. M. G. Van Voorhis. *Nat. Petrol. News*, 19.4.39, **31** (16), R. 156.—The advances made in high-speed diesel-engine design are reflected in the more general character of fuel specifications and in the elimination from the specifications of special items which have often involved the refiner in difficulty. The widening of the viscosity specification makes it possible, in some cases, to meet the demands for certain grades of domestic heating oil and diesel oil with a single grade. Viscosity, in certain instances, has been eliminated altogether from specifications. Opinion is divided as to the value of cracked gas oil as a diesel fuel, but at present more than sufficient straight-run oil is available.

The correlation of specification requirements with ignition quality is still unsatisfactory, and even the cetane number, although the best index, is not the ideal criterion. The cleanliness problem is solved technically, and the education of the distributor and user is all that is necessary to eliminate trouble from this source entirely. H. G.

Lubricants and Lubrication.

957. Arylstearic Acids from Oleic Acid. A. J. Stirton and R. F. Peterson. *Industr Engng Chem.*, 1939, **31** (7), 856.—Various analogues of phenylstearic acid have been prepared by the Friedel–Craft reaction with the intention of their being tested as addition agents to lubricants. The following compounds have been prepared: *p*-tolylstearic, *p*-chlorophenylstearic, *p*-bromophenylstearic, *p*-methoxyphenylstearic, *p*-phenoxyphenylstearic, and *p*-xenylstearic acids. Other possible uses under consideration include the uses of such compounds in the manufacture of soaps, wetting agents, and waxes. The alkyl oleates behave in a similar fashion to oleic acid in the Friedel–Craft reaction with an aromatic compound. The preparations illustrate the generality of the reaction of oleic acid or an oleate with aromatic compounds. H. E. T.

958. Effect of Fatty Acid Derivative on Lubricants. Part III. A. W. Ralston and E. J. Hoffman. *Nat. Petrol. News*, 19.4.39, **31** (16), R. 150.—Acylated courmarone and indene resins prepared by the condensation of fatty acid chlorides with resin fractions materially lower the pour points of paraffinic lubricating oils to which they are added. The mechanism of the lowering is shown to be due to a modification of the crystal size and crystal structure of the constituent wax, which suffers a continuous change from the clearly defined crystalline to the amorphous state with increasing amounts of the additive.

When tested on a Stephen's consistometer the treated oils show smaller temperature increases than do untreated oils, indicating lower internal friction and greater lubricating value. H. G.

959. Trends in Lubricating-oil Manufacture. G. F. Fitzgerald. *Petrol. Engr*, Mid-year 1939, **10** (10), 105.—The recent widespread transition to the solvent refining of lubricating oils has necessitated more attention being paid to the rigid supervision of plant to maintain optimum conditions in dewaxing and extraction; and has necessitated very high capital outlays, particularly for control equipment. Two-thirds of the world's dewaxing capacity uses benzol ketone, whilst propane dewaxing is next in importance, providing a method of removing resins as well as wax, and thus increasing the yield of the neutral oils and reducing filter losses as well as improving quality. Solvent extraction has greatly increased the range of crudes that can be used for lubricating-oil manufacture. Furfural is the most widely used solvent, Duosol, phenol, and SO_2–benzol following very closely, with chlorex approximately one-fourth of that of furfural. Furfural is generally preferred owing to the normal temperatures (150–250° F.) used in extraction. For paraffinic oils the removal of 5–10% extract improves the viscosity index by about 1 for each per cent. extracted. For naphthenic oils the extract losses are greater, but are counterbalanced by the lower cost of the crude material. Solvent-treated oils are now replacing to some extent the purely paraffinic oils previously demanded, owing to their greater oxidation stability and lower liability to form gum and carbon.

De-resination and de-asphaltization are also being effected by distillation with a close-cut petroleum product—used as a "carrier"—enabling cylinder stocks and bright stocks to be run to less than 2% bottoms. This method is stated to be more economical than solvent refining, and yields distillates of lower carbon residue. For the decolorizing of lubricating oils, Fuller's earth is being replaced by bauxite and activated earths of improved quality. Attempts have been made, with some success, to refine in the still with clay added to the charge the clay dropping to the bottom of the tower.

Research is being carried out on extreme pressure and diesel-engine lubricants, on the chemical composition of lubricants, the catalytic effect of metals on lubricating-oil deterioration and inhibitors to prevent this, as well as inhibitors to lower pour point, prevent varnish formation and bearing corrosion, to increase oiliness, and to raise the viscosity index. C. L. G.

960. Formation of Products Insoluble in Chloroform by Artificial Oxidation of Lubricating Oils. Dixmier and Lyon. *II^me Congrès Mond. Pétrole*, **2** (Sect. 2), 731–738.—Tests are described on used lubricating oils. An approximate relationship is given between the percentage weight of compounds insoluble in petroleum ether and compounds insoluble in chloroform. Unused oils were heated in sealed glass bulbs at temperatures varying from 140° C. to 410° C. with and without copper catalyst. Compounds insoluble in chloroform are formed only at the higher temperatures (350–400° C.), but these contain much less oxygen than those obtained from the used oils. It is suggested that the chloroform-insoluble material is formed in practice by alternate heating and cooling in an oxidizing atmosphere. R. R. F.

961. Carbonization of Lubricants. J. Damian. *II^me Congrès Mond. Pétrole*, **2** (Sect. 2), 739–744.—The production of carbon from lubricating oils in internal-combustion engines is discussed.

An apparatus is described in which the carbonization of lubricants at temperatures between 200° and 550° C. in the absence of flame and under conditions similar to those occurring in the cylinder of an engine may be studied; a curve for the variation of carbon deposit with temperature is given. J. L. E.

962. Oils for Internal Combustion Engines. F. Van Lierde. *II^me Congrès Mond. Pétrole*, **2** (Sect. 2), 745–749.—A classification of lubricating oils based on viscosity index, stability, and pour test is described.

The viscosity index and stability afford information relating to the behaviour of the oil in service and to its resistance to dilution and oxidation; the viscosity index and pour test provide indication of ease of starting and engine wear. J. L. E.

963. Oxidation of Mineral Oils at High Temperature. A. Maillard. *II^me Congrès Mond. Pétrole*, **2** (Sect. 2), 751–755.—A study of asphaltic, carbonaceous, and mineral

contents of samples of oil from crankcases of marine diesel engines and internal-combustion engines has been made.

The results obtained showed that deterioration of oils leads to products differing from those usually obtained by ordinary methods in the laboratory; experiments are being carried out on oxidation at high temperature in order to ascertain the conditions which most nearly approach those found in practice. J. L. E.

964. Methods and Equipment Used in the Development of Lubricants for High Output Service with Special Reference to Aviation Oils. C. H. Baxley and J. P. Stewart. *II^me Congrès Mond. Pétrole*, **2** (Sect. 2), 757–769.—A single-cylinder air-cooled engine consisting of parts with dimensions similar to those used in multi-cylinder engines has been modified to give conditions of oil temperature similar to those experienced in practice. Temperatures of oil and mechanical parts are reproducible and the amount of oil in circulation, in particular that thrown to the cylinder walls, is carefully controlled, since this is found to be critical in the deterioration of the oil. Special selection of mechanical parts, even within specification limits, is essential, since these affect the time for ring-sticking. Operating factors such as mixture ratio and temperature are controlled. R. C. W.

965. Condition of Lubricating Oil after Use in High-speed Oil Engines. A. T. Wilford. *II^me Congrès Mond. Pétrole*, **2** (Sect. 2), 771–779.—Tests on used oils indicate that carbon content, ash, diluent, and increases in viscosity and acidity of an oil depend on engine type and oil consumption rather than on the oil itself. Used oils are less resistant to laboratory oxidation tests, and the hard asphalt content of used oils shows qualitative agreement with that obtained after laboratory oxidation tests. A figure of 8%-wt. of carbon is considered as critical when considering engine failure. R. C. W.

966. Selection and Care of Oils for Steam Turbines. G. Baum. *II^me Congrès Mond. Pétrole*, **2** (Sect. 2), 781–789.—The properties on which turbine oils are generally selected and the standard test regulations specified by various Standardizing Committees are critically discussed.

Refining processes are dealt with, but it is emphasized that careful treatment of the oil during its period of service is more important than its chemical treatment during refining. Care of the oil in service is discussed, and the importance of efficient oil coolers and collectors, etc., is stressed.

Reference is made to the possibility of regenerating oil after deterioration with age. J. L. E.

967. Studies in Lubrication. V. The Theory of Thick Film Lubrication of Flooded Journal Bearings and Bearings with Circumferential Grooves. M. Muskat and F. Morgan. *J. Appl. Phys.*, 1939, **10** (6), 398.—An extension of the method previously developed for finite length bearings fed with lubricant sources (*J. Appl. Phys.*, 1939, **10**, 46) is applied to flooded bearings of finite length. The results are expressed in three graphs: (*a*) journal eccentricity against Sommerfeld criterion, S; (*b*) relative load-carrying capacity against eccentricity; (*c*) coefficient of friction against S. In each case a series of lines of constant bearing length to bearing diameter ratio $\bar{\omega}$ are plotted. It is shown that eccentricities and friction coefficients, for fixed values of S, decrease as $\bar{\omega}$ increases, whilst the load-carrying capacity for fixed eccentricity increases.

The effect of a central groove is to give two bearings each with characteristics determined by the value of $\bar{\omega}$ for the two halves. The main advantage of such an arrangement must therefore lie in the cooling produced by the increased flow of oil and in overcoming negative pressures which might result in film rupture in the case of a flooded bearing. P. D.

968. Patents on Lubricating Oil. Ruhrchemie A.-G. E.P. 504,350, 19.4.39. Appl. 19.10.37. Synthetic production of lubricating oils by condensation of hydrocarbons containing olefines using aluminium chloride as condensation agent. The hydrocarbons used are benzines obtained by cracking at 460–510° C. and under 4–12 atm. pressure,

mixtures of hydrocarbons obtained synthetically from CO and H_2 by the Fischer–Tropsch process, and boiling above 150° C.

H. D. Elkington. E.P. 505,141, 5.5.39. Appl. 10.6.38. Refining of lubricating oil with or without the addition of a diluent by treatment with strong acid and separating the acid sludge in the presence of a hydrocarbon treating agent of low mol. wt. at temperatures above the critical temperature of the agent.

H. D. Elkington. E.P. 506,228, 24.5.39. Appl. 10.6.38. Refining of lubricating oils with or without the addition of a diluent, by means of concentrated sulphuric acid.

H. G. Tovote. E.P. 506,532, 30.5.39. Appl. 30.11.37. Process and apparatus for improving the pour point of hydrocarbon mixtures containing wax.

F. M. Archibald. U.S.P. 2,157,315, 9.5.39. Appl. 28.11.36. Removing ash-forming constituents from a residual petroleum oil containing soaps dissolved therein (derived from acid refining followed by alkali wash), by adding sulphuric acid in the form of acid sludge.

S. W. Ferris. U.S.P. 2,157,821, 9.5.39. Appl. 3.7.33. Refining of lubricating oils by means of nitrobenzene and a low-boiling hydrocarbon diluent, *e.g.*, naphtha.

L. R. Evans. U.S.P. 2,158,358, 16.5.39. Appl. 34.2.37. Dewaxing hydrocarbon oil in the presence of a wax crystal modifying substance, *e.g.*, crude montan wax, aluminium stearate, etc.

F. X. Govers. U.S.P. 2,158,360, 16.5.39. Appl. 29.3.32. Manufacture of low pour test high v.i. lubricating oil from wax-bearing mineral oil by means of liquid SO_2 and monochlorbenzol.

F. X. Govers. U.S.P. 2,158,361, 16.5.39. Appl. 16.9.32. Solvent extraction of hydrocarbon oil using an aliphatic ether selected from the group consisting of *iso*-propyl and ethyl ether.

E. C. Knowles. U.S.P. 2,158,370, 16.5.39. Appl. 3.3.37. Dewaxing hydrocarbon oil by means of evaporative cooling.

E. G. Ragatz. U.S.P. 2,158,425, 16.5.39. Appl. 4.1.36. Method and apparatus for the vacuum distillation of lubricating oils.

D. E. Carr and M. L. Wade. U.S.P. 2,158,671, 16.5.39. Appl. 26.8.35. Dewaxing of hydrocarbon oils using propane and an oxidized wax.

D. E. Carr and M. L. Wade. U.S.P. 2,158,672, 16.5.39. Appl. 15.12.36. Dewaxing of hydrocarbon in which the oil is first subjected to the action of oxygen-containing gases at 150–500° F. for a time which is insufficient to oxidize more than 5% of the oil. The oil is then dewaxed.

W. B. McCluer and M. R. Fenske. U.S.P. 2,159,444, 23.5.39. Appl. 23.6.34. Solvent extraction of hydrocarbon oil using methyl ethyl ketone.

T. A. La Brecque. U.S.P. 2,159,994, 30.5.39. Appl. 14.11.36. Reclaiming apparatus for hydrocarbon oils.

W. W. Kraft and W. J. Bloomer. U.S.P. 2,160,103, 30.5.39. Appl. 23.4.35. Distillation of residues containing small percentages of asphalt in the presence of a diluent, to recover lubricating-oil stocks.

B. G. Aldridge and E. G. Ragatz. U.S.P. 2,160,256, 30.5.39. Appl. 10.7.34. Vacuum distillation of oils.

B. S. Greenfelder and M. E. Spaght. U.S.P. 2,160,573, 30.5.39. Appl. 27.8.38. Separation of wax in dewaxing processes for hydrocarbon oils, in the presence of a diluent containing N_2 bases separated from a cracked mineral-oil distillate boiling between 115° and 330° C. W. S. E. C.

See also Abstracts Nos. 912, 913, 941, 942 and 950.

Asphalt and Bitumen.

969. Recovery of Bitumen from Solutions and Mechanical Mixtures. H. Kamptner. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 637–644.—The effect of various organic solvents on the properties of bitumen recovered from solution is considered. Carbon disulphide and benzol are recommended.

The author discusses the effects of distillation processes and gives details of an apparatus for vacuum distillation wherein the bitumen solution is exposed as a thin film, thus reducing time and temperature of distillation.

A special apparatus for centrifugal extraction of bituminous mixtures is described. W. P.

970. New Methods for Examination of Liquid Asphaltic Bitumen. M. C. Siegmann. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 645–652.—Two methods have been worked out to meet the following needs :—

(*a*) To recover and examine the whole of the binder present in a road (at any stage in its life) made with a cut-back asphaltic bitumen.

(*b*) To determine with reasonable accuracy the amount and quality of the basic asphaltic bitumen and of the volatile fluxing distillate in such a binder, or in any cut-back asphaltic bitumen of unknown origin.

The methods used are briefly as follows :—

(*a*) Extraction with CS_2 followed by fractionation quantitatively to separate the CS_2, leaving the whole of the binder.

(*b*) Closely defined and carefully controlled steam distillation.

Although the methods are tentative, it is stated that no others are known which can give equally reliable information. C. F. J.

971. Penetration of Bitumen. P. Woog, J. Givaudon and L. Daulin. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 655–657.—An investigation of hysteresis effects associated with the penetration test. It is shown that prolonged periods of cooling at atmospheric temperature (*e.g.*, 14 hrs.) result in figures 15% low. Free circulation of air during air cooling is stressed as well as thorough agitation of the water-bath.

An exact procedure is given. C. F. J.

972. Apparatus for Determining the Electric Strength of Filling Compounds for Jointing Boxes. G. W. Nederbragt. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 653–654.—The apparatus is fitted with flat electrodes which can be fixed and maintained at any desired distance.

Filling compounds such as asphaltic bitumens can be examined in the two following ways :—

1. A prescribed constant voltage is applied, and it is ascertained whether this can be maintained for a given length of time without breakdown taking place.
2. The voltage, starting from a low value, is increased at a constant rate until breakdown occurs. C. F. J.

973. Ductility of Asphaltic Bitumens. J. P. Pfeiffer and R. N. J. Saal. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 665–671.—The author discusses to what extent ductility measurements are a measure of cohesion of asphaltic bitumens.

The behaviour of an asphaltic bitumen in the ductility test is governed by the rheological properties of the bitumen, but the problem is so complicated that exact analysis is not yet possible. The judgment of bitumen in terms of ductility at one temperature or one rate of elongation may be very misleading. W. P.

974. Physico-chemical Researches on Bitumen Emulsions. E. Vellinger and G. Radulesco. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 659–664.—The degree of dispersion of bitumen emulsions (prepared in a high-speed mixer) is determined by the p_H of the aqueous phase. NaOH solutions in the absence of other emulsifying agents give stable emulsions only over a narrow range of p_H, the range depending on the type

of bitumen. Addition of other emulsifiers (*e.g.*, oleine) considerably widens the p_H range over which fine dispersions are obtained.

At the p_H giving the finest dispersion, stability is a maximum, and sedimentation a minimum; sedimentation may be modified, however, by the electric charge on the particles.

In certain cases there is a maximum viscosity at a certain p_H of the aqueous phase. The viscosity can be increased by the addition of stearic or sulphonic acids, the former producing structural viscosity and marked thixotropy. Sulphonic acids do not give thixotropic emulsions, but tend to produce scum, particularly at low p_H.

Coagulation of emulsions by gravel, etc., decreases with increasing p_H and fineness of dispersion. Addition of salts to control p_H results in a rapid fall of viscosity, and is therefore not a practicable method of adjusting stability.

Storage stability generally improves with increasing fineness of dispersion, but no definite correlation is to be observed. W. L. P.

975. Emulsions in Industry. H. L. Bennister and A. King. *Chem. & Ind.*, 1939, **58**, 220–223.—The authors discuss the paper industry with particular reference to the sizing of either the pulp or the finished product. Reference is made to the use of rosin, paraffin, carnauba, or montan wax emulsion as *beater-sizing* materials for admixture with the pulp. These emulsions are generally broken down in the pulp by the addition of alum. Papers made in this way are deficient in mechanical strength, although some of the modern synthetic waxes give better results.

For the preparation of special papers by means of bituminous emulsions, soap, glue, and clay are the emulsifying agents generally used, emulsions are added to the pulp at the beater stage and must be stable. Clays are considered better than soap, in spite of the increased weight of the paper, and sulphite lyes appear to be better than either. Coarse emulsions prepared by emulsifying with colloidal pastes of carbon dust, silica gel, or metal hydroxides are also satisfactorily employed. It is stated that the emulsifier for wax and bitumen should be inert and should cause the dispersed product to adhere to the films, but this does not appear to have been achieved at present.

The adoption of *surface-sizing* with emulsions, particularly with wax, has enabled the undoubted advantages of wax to be utilized without subsequent loss of paper strength. Satisfactory emulsions and methods of application at high speeds do not appear to have been obtained yet. Other emulsified materials used include nitrocellulose, for which new type emulsifying agents such as sodium butyl-naphthyl sulphonate are used; plasticizers must be used, and synthetic resins are normally required to impart special characteristics. Rubber latex is not generally satisfactory. H. G. W.

976. Manufacture and Use of Asphalts for Low Cost Road Construction in Canada. J. E. Easterbrook and R. K. Stratford. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 687–692.—A survey is given of road development and of commercial production of asphaltic bitumen in Canada. The change from sheet-asphalt construction to low-cost types necessitated experimental and development work which is briefly surveyed. W. P.

977. Manufacture of Bitumens for Use in Road Construction. L. Hemmer and R. Flavigny. *II^me Congrès Mond. Pétrole*, 1937, **2** (Sect. 2), 673–685.—The important properties of a bitumen in relation to road construction are consistency and adhesivity. Consistency is discussed in terms of conventional tests and of composition while adhesivity is discussed in terms of surface equilibrium, particularly in the system bitumen–stone–water. Variation in adhesion with the type of stone and the possibility of improving adhesion by treatment of the bitumen are discussed.

The emulsification of bitumens is discussed in relation to their origin and method of preparation but it is shown that emulsification is also greatly affected by the nature of the process and emulsifying agents used.

The production of more suitable bitumens for road construction has become increasingly possible with improved technique of production. W. P.

978. A New Laboratory Test for the Durability of Road Binders. H. C. Bennett and D. W. Parkes. *Chem. & Ind.*, 1939, **58**, 565–572.—The so-called "rubber-strip test" of these authors is an effort to embody in a single test all those properties which contribute to the durability of a road-binder. Preliminary correlation with accelerated carpet tests on the road showed that the most satisfactory were those in which the binder was found to be ductile after weathering, and that a measure of the ductility before weathering was no guide to its behaviour after weathering. The best results were obtained with a standard base tar, oiled back with a very heavy oil, and this was found to be most suitable for open-type carpets, but unsuitable for other types of road work. The test in its present form consisted in applying a film of binder 18 mm. square by 0·005 in. thick automatically (or by hand) on a sheet of rubber. The test strips were then artificially weathered by placing them absolutely level in a ventilated oven at 40 ± 0·5° C., and the critical temperature observed at which the film cracked completely across when elongated 33%, details and diagrams of the apparatus being given. Each binder was weathered for five periods up to 72 hrs., and the critical temperature plotted for each period against the time of weathering. In general, good correlation had again been observed between the behaviour in service and the type of curve obtained in this test, and it was found that binders with high critical temperatures, *after weathering* and showing curves with steep slopes, did not give satisfactory results in use. This will be confirmed by further work. Further investigation has shown that the durability of binders is scarcely affected by the quantity or viscosity of the oiling-back oil, within the range 100–300 sec. (B.R.T.A. at 30° C.), but was strongly influenced by the quality, and that, if a heavy-oil binder was stored at an elevated temperature, deterioration occurred, not revealed by standard distillation tests, but shown by high critical temperature curves in the rubber strip test. It is pointed out that the significance of the figures will depend on the method of curing the binder on the road, but in types of road construction where the binder was submitted in the form of a thin film to maximum atmospheric exposure, it had, however, been proved that the test in its present form gave a very fair idea of durability.

H. G. W.

979. Examination of Road Wear. H. Booth. *Chem. & Ind.*, 1939, **58**, 501–507.—The author points out that it is desirable to measure numerically any kind of change that occurs on a road, so that it can be plotted against time, traffic, and weather to ascertain the real cause and to correlate it exactly with the proper accelerated laboratory test. Visual inspections are carried out at sufficiently close intervals to note any sudden changes in the road surface and photographs taken, if necessary. In road tests all the measuring instruments are used at the beginning of the test at short intervals, and these intervals gradually increased until the largest advisable, which may be three-monthly, are found. The *slipperiness* of roads, particularly on wet surfaces, is measured by the sideway force coefficient of a motor-cycle with a skew wheel on the side-car up to about 50 m.p.h. and with a high-speed car up to 70 m.p.h. Rapid auxiliary methods of estimating slipperiness are the texture print of the surface and the roughness index (obtained by spreading standard sand as far as possible over the surface), and these are particularly useful for showing the gradual smoothing or disintegration of a road. The latter has been found that on a normal road this figure falls to a reasonably steady value after 12 months. The *disintegration* of the road is measured by weighing the amount of stone thrown to the side of the road daily, and the results show that the amounts lost are in general a function of temperature and are greater the colder the day. Alternatively, the rate of formation of pot-holes can be used as a criterion of road disintegration. *Surface irregularity* is measured on a sixteen-wheeled carriage by a single indicating wheel in the centre by (*a*) a profilograph or (*b*) a rise integrator, which measures the total unevenness upwards as per mile, or (*c*) a classifier, which counts the number of rises between successive fixed amounts differing by 0·1 in., and is found to decrease on a normal road to a constant figure after about 6 months; transverse profiles are also taken to give the change in level after making. Reference is made to various other methods for examining the state of a road surface, such as (*a*) photographic views for accidental damage and repairs and to find out whether severe breaking contributes to road failure, (*b*) plaster casts of the road surface, (*c*) deflection of a sheet of rubber by direct pressure to measure surface roughness, (*d*)

counting the stones lost from a surface, and (*c*) tentative methods of measuring road hardness. The paper concludes with a brief account of the statistical records that are made of certain influences that affect road wear—namely, traffic tonnage and transverse distribution of traffic (using the axle counter), road-surface temperature and the duration of wet and dry surface conditions (using the wet road clock). In general, the four most heavily loaded 1-ft. strips on a 30-ft. carriage-way are about 4 and 10 ft. away from each kerb. H. G. W.

Special Products.

980. Dehydration of Organic Liquids with Activated Alumina. R. B. Derr and C. B. Willmore. *Industr. Engng Chem.*, 1939, **31** (7), 866.—The application of activated alumina to the drying of organic liquids is discussed. Experimental results on the drying of ethyl and butyl acetates, pyridine and gasoline, are reported. A commercial scale unit at present in operation for the drying of benzene and toluene is described, and applications of drying by activated alumina to catalytic processes and the production of high-grade water-free organic solvents are indicated. H. E. T.

981. Oils for Transformer and Switch-gear. H. Richter. *II^me Congrès Mond. Pétrole*, **2** (Sect. 2), 693–698.—The selection and treatment of oils to be used for transformers and switch-gear are dealt with; the effect of ageing is discussed, and the importance of appropriate care of the oil is emphasized. J. L. E.

982. Catalytic Change in Mineral Oils used for Transformers. M. M. Muller. *II^me Congrès Mond. Pétrole*, **2** (Sect. 2), 698–706.—Changes in mineral oils have been studied by following the absorption of gaseous oxygen in the oils heated to various temperatures below 150° C.; the effect of catalysts (copper and copper stearate) has also been studied.

At temperatures below 150° C. over-refined oils absorb much more oxygen than do less highly refined ones; above 150° C. the volume of oxygen absorbed by all oils is about the same.

The results obtained are applied to a study of oil stability. J. L. E.

983. Use of Anti-oxidants in Transformer Oils. E. Vellinger and N. Saito. *II^me Congrès Mond. Pétrole*, **2** (Sect. 2), 707–712.—The stabilization of over-refined transformer oils by the use of anti-oxidants has been studied systematically at several temperatures and concentrations.

Twenty-two common anti-oxidants were considered, and the effect of the source of the oil on the efficiency of several of these was determined.

Finally, the decrease in efficiency of anti-oxidants in the presence of oxidation catalysts such as Cu and Cu stearate was demonstrated. J. K.

984. Action of Sparks and Electric Arc on Mineral Oils. A. Maillard and Chibaeff. *II^me Congrès Mond. Pétrole*, **2** (Sect. 2), 713–716.—The action of an electric arc on mineral oils has been studied. Variations in the physical properties of the oil and the quantity of carbon produced have been determined.

After a sufficiently large number of discharges, enrichment of the oil by heavy products soluble in it and formation of an insoluble deposit occurred.

In a high-tension system such as was used explosions could occur with the combustible gaseous mixtures without the actual presence of sparks. J. L. E.

985. Patents on Special Products. W. A. Farenholtz, G. Hubbe and H. Hubbe. E. P. 506,104, 23.5.39. Appl. 8.6.38. Production of oxidation products (*e.g.*, of fatty acids and alcohols) from hydrocarbons of high molecular weight, by oxidation with gaseous oxidizing agents.

C. A. Jacobson. U.S.P. 2,156,591, 2.5.39. Appl. 29.6.36. Manufacture of carburized silica from coal-tar and finely divided siliceous product of the nature of diatomaceous earth. W. S. E. C.

Detonation and Engines.

986. Diesels. L. J. Logan. *Refiner*, 1939, **18** (4), 165.—A general survey of the use of the diesel in U.S.A. In 1938 the use of diesel oil by the railroads to power passenger trains increased 82%, although the total quantity of all fuels consumed in passenger service declined by 6%. Operating economies of 50% or more apparently explain the increased use. Based on car-mile operation in passenger service, diesel oil cost 1 cent, as against 2–3½ cents for other fuels. In yard-switching or goods service diesel-oil economy was even more clearly demonstrated, with costs per locomotive hour of only 28 cents, against comparative fuel costs of 1 dollar or more. The use of diesel engines in power-stations, tractors, trucks, and pumping-stations is also discussed.

G. R. N.

987. Utilization of Waste Heat from Diesel Engines. H. J. Fountain. *Diesel Eng. Us. Ass.*, Pub. No. S. 151, paper read 8th March, 1939.—The general method at present in use for the utilization of waste heat from diesel engines is the absorption of the heat from the exhaust and jackets in water contained in a boiler, the design of which is determined by the purpose for which the waste heat is to be used. For heating and drying the required heat may be obtained by circulating the jacket-water in pipes through the buildings. Where diesel-electric plant is fitted and there is a demand for heat, a silencer-electric boiler is recommended for improving load factor and heat output at light loads. Where electric power is the primary consideration, an additional steam-driven generator is indicated. For refrigeration or air-conditioning plants, high-pressure steam can be generated in silencer boilers and used in conjunction with refrigerators of the steam-jet type.

The complete layout of a comprehensive heat-utilization scheme for power, heat and cooling, adopting some of the above principles, is outlined and the cost of operation indicated. Details are also given of many specific examples of utilization of waste heat in engineering works, power-stations, railways, and in other land and marine installations. The author finally indicates the directions in which utilization could be made of the vast quantities of waste heat available from aeroplane engines.

T. E. P.

988. Piston-ring Blow-by on High-speed Petrol Engines. C. G. Williams and H. A. Young. *Engineering*, 1939, **167** (3830), 693; (3831), 723.—A wide variety of tests were carried out on one four-cylinder and also on two 500-c.c. O.H.V. single-cylinder engines, one air-cooled, and the other water-cooled. A brief description of the plant and of each test as it was carried out is given and the following conclusions are reached. The general tendency is for blow-by to be constant or to rise slightly until a critical engine speed is reached above which it rises very rapidly and becomes excessive. This rapid increase of blow-by is attributed to "ring flutter," or vibration of the rings in their grooves. High B.M.E.P.s tend to increase the critical speed for "flutter," whilst large side clearances of the rings and low radial pressures lead to flutter at comparatively low speeds; for this reason good design indicates narrow high-pressure rings with small side clearance, although some compromise is required. Reduction of blow-by at high speed can be achieved by reducing the clearance behind the rings, thus limiting their amplitude of vibration, and also by having very large ring gaps (0·15 in.), which prevent breakage by the ends of the rings butting together, although such large gaps cause increased blow-by at low speeds. The viscosity of the lubricating oil has no effect whatever on the amount of blow-by past the rings. Ignition timing has the effect of increasing blow-by as the spark is advanced.

The authors have liberally illustrated this article with diagrams and curves, and from their conclusions put forward a tentative theory for "ring flutter." T. E. P.

989. Influence of Speed on Heat Loss in Petrol Engines. W. T. David. *Engineer*, 1939, **167** (4354), 765.—The author investigates the influence of speed on the heat losses to the cylinder head and barrel, exhaust valves, ports, and passages in petrol engines in connection with the design of cooling arrangements.

The results indicate that the rate of heat loss through the cylinder head and barrel is practically constant and independent of speed, whilst the rate of heat loss to the

exhaust system (*i.e.*, exhaust valves, ports, and those parts subjected to scrubbing by the exhaust gases) varies almost directly with the speed. For this reason the sleeve-valve engine with short ports is much easier to cool than a poppet-valve engine with long exhaust passages.

Figures for the distribution of heat to cooling water at various speeds are tabulated for engines of both poppet and sleeve-valve types. T. E. P.

990. Laboratory Method for Indicating Road Performance of Motor Fuels. H. G. Smith. *Refiner*, 1939, **18**, 177.—The main difficulty in developing a laboratory method to assess the road performance of motor fuels lies in the time element for loading the engine and picking up speed. An inertia–load system for absorbing power by means of a suitably designed flywheel with shaft on roller bearings affords a time interval of about 90 sec. for observations. The A.I.L. test unit (acceleration–inertia–load) employs a 2550-lb. alloy steel flywheel having an inertia of the order of an average weight car upon acceleration, in combination with a 240-h.p. hydraulic dynamometer for decelerating the engine. The motor fuel to be tested is rated successively in a Standard Ford V-8, 85-h.p. unit, a standard Chevrolet unit, and a standard Plymouth unit. Secondary reference fuels A, C, and F, ranging from 40 to 90 octane number, are used to bracket the fuel. To establish a working basis a straight-run aviation gasoline of 70·5–71·5 octane number is always initially tested.

After normal running conditions are obtained, the water is drained from the dynamometer so that the entire loading of the engine is affected by the inertia of the flywheel. The engine fuel supply is switched to the sample under test. At 8 m.p.h., with the transmission in high gear, the throttle is opened to the point of maximum knock, and knock intensity is determined at increasing speeds up to 35 m.p.h., the ratings being none, trace, light, light medium, heavy medium, heavy, or destructive. The procedure is repeated with blends of the reference fuels that bracket the test fuel. The octane number of the sample is then determined from the C.F.R.–A.S.T.M. calibration curve. The A.I.L. road rating is the average of the ratings in the three different types of engines. The results on 246 samples rated by a complete series of tests in all three engines indicated a reproducibility of $\pm$ one octane number. G. R. N.

Coal and Shale.

991. Coal Dust as Engine Fuel. Anon. *Chem. Trade J.*, 31.3.39, **104**, 311.—In a survey of the development of the coal-dust engine the view is expressed that it is now ready for service trial. The use of wear-resisting steels has resulted in extensive reduction of cylinder wear, whilst contamination of the lubricant is avoided by the provision of special stuffing-boxes. It is claimed that the problem of the choking of the dust-valves is almost solved. The principle of the operation of the engine is described.

R. J. E.

992. Additive for "Dust-proofing" Oils. Anon. *Nat. Petrol. News*, 17.5.39, **31** (20), R. 214.—According to the annual report of the British Fuel Research Station, the addition of 0·5% rubber or of a commercial substance of mol. wt. 50,000–100,000 (understood to be an *iso*butylene polymer) greatly improves the efficiency of oils used for dust-proofing coals. The function of these additives is to close the entrances to the pores, prevent the penetration of the oil into the coal, and so to reduce the quantity of oil required. Little evidence has been found to support the claim made in some quarters that the oil treatment of coal improves the combustion characteristics and weathering. H. G.

993. Low-temperature Carbonisation, Ltd. Anon. *Chem. & Ind.*, 1939, **58**, 492–494.—A general description of the plant and process at the "Coalite" Works at Bolsover.

The coal, mined in the adjoining colliery, is washed to about 3% ash. From the washing plant the coal is conveyed to concrete bunkers. There are sixteen of these, and each is 70 ft. high. As several seams of coal are used and they have to be blended in very precise proportion, each type of coal is isolated in its alloted bunker. The coal

is blended by adjustment of the speed of electrically operated conveyors running from each bunker. The final mixture passes by elevators and conveyors to the retort feed-bunkers, situated above the eight batteries of retorts which hold about 500 tons of coal—approx. 24 hrs. supply.

Condensed crude oil from the retorts passes to storage tanks, whilst the uncondensed gas passes to electrostatic precipitation chambers, where it is subjected to a static discharge of 80,000 volts in order to remove all suspended matter. The gas is then stripped of petrol and returned to gas-holders for use as fuel on the plant. Ammonia may be extracted as the sulphate, and there is a good demand for this fertilizer in the locality.

The crude oil is split into four oil fractions and pitch in a pipestill unit. Most of the oil fractions are rich in phenolic bodies, and these are removed by caustic-soda washing.

The washed oil is worked up for petrol and diesel oil.

The cresylate is subjected to a series of purification treatments and then hydrolysed by acidification with CO_2 generated from coke in producers. The cresylate acids are 99–100% pure. Caustic soda is produced on the plant, and there will eventually be four causticizers each of 11,000 gal. capacity.

Owing to the temperature employed and the method of distillation, the germicidal value of some of the tar acids is almost four times as great as that of standard products from other sources. T. C. G. T.

BOOK REVIEWS.

Theory of Lubrication. By Mayo Dyer Hersey. 2nd Edition, 1938. Pp. xi + 175. J. Wiley & Sons, Inc., New York, and Chapman & Hall, Ltd., London. Price 12*s.* 6*d.*

The book is based on a series of lectures on the mechanics of lubrication, given at Brown University in 1934, and repeated at Yale University and Massachusetts Institute of Technology in 1935. These lectures aimed at giving the scientific background of modern lubrication.

The book is addressed to the graduate, and not directly to the undergraduate. However, although there is much in the text which is advanced knowledge, there is also much which can be read and appreciated by the intelligent student. Engineers will find the subject interesting and helpful. The wave of simplification which traverses the several lectures must encourage the timid reader to carry on, although at first sight the mathematical aspect may be formidable.

The first chapter is devoted to an historical introduction. The second chapter deals with viscosity and its relation to friction. As viscosity is the most important property of a lubricant, a true concept should be available. To show the practical nature of the subject, a numerical example is given. Then follows a chapter on hydrodynamic theory. Generally, reports on this theory are pretty hard reading, so it becomes pleasant to read of it with a little less tension.

Temperature rise in bearings has always been a matter of consideration, but to-day it is a high light in engine design. Whilst we may not know and cannot ascertain surface temperatures within the bearing unit, we can content ourselves with, and make good use of, such material as is available when considering temperature distribution in the metal and in the oil film.

Oiliness has been a fundamental problem since 1896, when Kingsbury was struggling with this unsolved problem. Many tests, both static and kinetic, have been advocated in the attempt to evaluate relative oiliness of different lubricants. Some of them have contributed to what appears to be a crystallization of the phenomenon. The variables and difficulties in the experimental work are clearly outlined by Hersey.

Many of us glance through a book and form hurried opinions, but the author of "Theory of Lubrication" has given a summary towards the end of the book to enable the reader to obtain a panoramic view. Finally, as a postscript, he continues with a chapter on Recent Developments. It is therefore correct to say that the book is up to date to the end of 1937.

The opinion of the reviewer is that the book is exceedingly well written, and must make a lasting impression on the mind which is interested in the science of lubrication.

E. A. Evans.

Piping Handbook. By J. H. Walker and S. Crocker. Third Edition, 1939. Pp. xi + 897. McGraw-Hill Publishing Company, Ltd., London, W.C. 2. Price 36*s.*

The well-known "Piping Handbook" by Messrs. J. H. Walker and Sabin Crocker has been revised and brought up to date in the third edition just received. This exhaustive treatise covers a wide field of engineering practice as applied to pipework, and embodies authoritative information culled from numerous specialists in the various phases of this important subject.

The rapid advance of modern industrial process continues to call for higher temperatures and pressures, and many long-established standards have, in consequence, been modified or abandoned to meet present-day conditions. These departures are described at length in the "Piping Handbook," and valuable information is given on the metallurgy of piping materials and their selection to suit

specific duties. The outstanding change in our time has undoubtedly been the universal adoption of welding both in works fabrication of piping and fittings and the elimination wherever possible of screwed or bolted joints in installation. This procedure has necessitated the introduction of many new standards, and a wealth of information is given in the handbook on production methods, stress relieving, dimensions, weights and test requirements, etc. The different types of flanged joints, screwed connections and proprietary joints and couplings now in use are classified and their merits discussed in relation to their particular application.

Very full information is given on the layout of piping systems with regard to flexibility, and the provision of supports and anchors to take care of the stresses encountered from temperature and pressure differences. The mathematical solution of numerous examples is given, and the data are of the greatest value to pipe-work designers and draughtsmen. Examples are also included of typical layouts and the essential requirements of systems dealing with a variety of gases and liquids. These examples are obviously the outcome of experience, and are therefore of practical value in avoiding the pitfalls so frequently met with in the transportation of fluids in pipes.

On the subject of flow of fluids in pipes the authors' adoption of the rational flow formula making use of Reynolds numbers for the solution of these problems is welcomed. Of flow formulæ, empirical or otherwise, it can be said without exaggeration "Their name is legion," and their indiscriminate use leads to results so conflicting as to be of no practical value. The relevant data in tabular and graphical form for the determination of significant factors and reduction to self-consistent units are most useful, and likewise the various practical examples show clearly the procedure to be adopted in the solution of flow problems.

The authors are to be congratulated on having compiled in a single volume so complete a survey of pipe practice of the present day, and on presenting this information to engineers in such a clear and concise form. J. R. HARKNESS.

Robbery Under Law. By Evelyn Waugh. Pp. 286. Chapman & Hall, London, 1939. Price 10*s.* 6*d.* net.

Mr. Waugh says that he went to Mexico to write a book about it in order to verify and reconsider impressions formed at a distance. The fact that his more intimate impressions were gathered during a visit of less than two months' duration raises the question whether any writer, however skilled he may be in observation and deduction, could possibly tell a true story about so complex a subject with material so rapidly acquired.

In his introductory remarks Mr. Waugh anticipates this question and supplies his answer, which is to the effect that such is the habit of professional writers, and that in this they are less presumptuous than the barrister or the medical specialist, who, with even less foreknowledge of the conditions surrounding their clients' case, can conduct a litigation or diagnose a disease.

Mr. Waugh's comparison is not a just one, however, and his book betrays him, for a very great number of his statements could only have been based on hearsay evidence which neither the lawyer nor the doctor would dream of accepting as a foundation for conducting the case of their clients.

Nevertheless for a reader who has resided in Mexico for any length of time and has had the opportunity of acquiring a real and intimate acquaintance with the life and character of its inhabitants, this book can be accepted as a very fair and accurate summary of the present state of affairs in that unhappy country.

For readers who have not had this opportunity many of Mr. Waugh's disclosures will appear unbelievable, but if they should feel any doubt about the possibility of such happenings as those described they should read "The Rosalie Evans' Letters from Mexico," a book which recounts the tragic history of a woman, the American wife of an English coffee-planter, who attempted single-handed to defend her dead husband's property in Mexico and who was murdered as a result, in spite of strenuous efforts by the British Government to secure protection for her from the Mexican Government. This episode occurred fifteen years ago, and is not mentioned by Mr. Waugh, but it is historically important, because it led to the withdrawal from Mexico of the British chargé d'affaires after he had vainly tried to protect Mrs.

Evans and had already become *persona non grata* to the Obregón Government because of his frequent protests against the unlawful seizure by that Government of British property and interests.

The recent barefaced theft of the foreign-owned oil properties has focused the attention of the civilized world upon the present, and still more corrupt and rapacious Cardenas régime. Mr. Waugh devotes 43 pages to an admirable and lucid exposition of the events leading up to this shameful episode, and of the heroic but vain struggles of the Companies to defend the legitimately acquired interests of their shareholders.

In a succeeding chapter, entitled " The Good Neighbour," the author discusses the interrelationship of the United States and Mexico from the time of the early English colonists to the present time. This chapter is amazing in its revelations and almost incredible in its implications.

Mexico is depicted here, not as a country of uncivilized Indians recently freed from the Spanish yoke and struggling to establish itself as an independent self-governing nation with the kindly advice and assistance of its northern neighbour. On the contrary, the Mexicans are shown to have been possessed of a civilization and culture far in advance of that prevalent in the United States during the colonial period, whilst the Good Neighbour is portrayed as a mischief-making busybody largely responsible for the unfortunate country's present troubles.

This arraignment of the United States before the bar of public opinion is a serious matter, and may well raise in the reader's mind the question whether Mr. Waugh is not going outside the province limited by his personal impressions when he accuses a United States Ambassador of being " tied up " with American commercial interests, of using the embassy as headquarters of those interests, and of deliberately setting himself to destroy the Madero administration because the latter was opposed to or in competition with such interests.

Further than this, Mr. Waugh makes out that in the two blackest crimes of recent Mexican history—the murders of Madero and Father Pro—there was in each case an American Ambassador at hand who alone could have averted it, and he finishes this chapter with the remark, " Once more, at a crucial moment in Mexican history, when a choice was imminent between further violent experiment and a return to saner counsels, the United States have lent their influence to the disorderly side."

Now, these and several other matters dealt with in this chapter could not have been enacted under the personal observation of Mr. Waugh. It is doubtful whether some of them—for instance, the circumstances surrounding the death of Madero and Pino Suarez—came within the personal cognizance of his informants, whoever they may be.

The remaining chapters of the book make gloomy reading to those who have known Mexico in quieter and more prosperous times. The country has already relapsed into stark anarchism, it is moving towards conditions which may easily provoke a world conflict.

Already, according to Mr. Waugh, the Monroe doctrine is being challenged by Germany all over South America, German and Italian business firms control important industries all over the continent, the air lines are predominantly German, with control of the landing-grounds, Italians are training the Bolivian army and the Lima police force, whilst in Mexico, on the Guatemala border, German planters have imported large quantities of arms and maintain a private defence force. It is far from fantastic to believe that in the event of political conditions in Mexico being propitious, Germany is prepared to intervene with vast, ready-made plans for taking control.

For the petroleum interests these pessimistic prognostications have a special significance; already the governments of other oil-producing countries in South America are showing a tendency to adopt a leftward policy, probably stimulated by pro-Nazi propaganda. Already they have seen that the Monroe doctrine has relapsed into a dog-in-the-manger attitude which opposes the intervention of foreign Powers in defence of their legitimate interests, but does nothing material to protect those interests under its implied guarantee.

This book should undoubtedly be widely read. Its readers may not agree entirely with Mr. Waugh's interpretation of his impressions, they may even see a ray of hope in his affirmation that there is a religious revival in progress that is transforming the Mexican Church; driven into the catacombs, the Church is recovering its spirit,

but whether this recovery can become effective in time to save the country from utter disintegration, political, social and moral, only time can show.

J. McConnell Sanders.

Das Erdöl im Weltkrieg. By F. Friedensburg. Pp. 131. Maps 4. Tables 34. Ferdinand Enke Verlag, Stuttgart. 1939. Price R.M. 10.

Statesmen and journalists alike have frequently stressed the part played by oil in deciding the outcome of the World War of 1914–18. Some have assigned to it the credit for the victory of the Allies—others have maintained that the competition for oil supplies was the main cause of the prolongation of hostilities. Numerous popular and sometimes sensational articles have been written during the last twenty years, but up till now no reliable and systematic analysis of the numerous international sources of literature on the subject, appears to have been made. The present book purposes not only to represent, by a careful sifting and examination of sources of information, a reliable estimation of the part played by oil in the course and outcome of the last war, but also to afford practical information regarding modern defence policy, presumably from a German point of view, regarding the supplies of this increasingly important raw material in any future conflict.

That the full significance of oil supplies was not appreciated at the beginning of the last war is shown by the failure in all countries to ration the civil consumption of petroleum products. Only a few people at first suspected, and then did not clearly realize, that the enormous increase in arms and munitions would lead to a revolution of the petroleum industry. This lack of foresight was due possibly to the generally accepted idea that the war would last only a few months. Gradually, however, the specific military requirements of petroleum made themselves felt in all the belligerent countries, and within a year rose to unforeseen magnitudes.

The author carefully analyses the question of oil supplies in connection with the various phases of the history of the war: the campaigns in Galicia, Roumania, and Mesopotamia; the advance of the Turkish army into the Caucasus, the closing of the Dardanelles, the submarine war, the English blockade, and the fight to maintain the neutrality of the non-belligerent countries. The disastrous effects of the underestimation of the importance of oil by Germany, resulting in her inability to develop her mechanized army, to build tanks, oil-fire her ships, expand her air force, or lubricate her industrial machinery is written with a bias which will, perhaps, not appeal to English readers. The author, however, in his final chapter concludes that while petroleum alone cannot be held responsible for the final outcome of the last war, it played a very considerable part in deciding the victory of the Allies—a fact which no one can dispute.

The interdependence of military requirements and industry—in other words, the significance of supplies of raw materials, and in particular that of petroleum in time of war—is a lesson surely learned by all countries. There can, however, be no harm in repeating the lesson—and this book should commend itself not only to those interested in the inside history of the last war, but to all those interested in any—we hope mythical—war of the future.

B. M. H. Tripp.

PUBLICATION RECEIVED.

Trinidad and Tobago. Mines. Report of the Inspector of Mines and Petroleum Technologist for 1938. Council Paper No. 53 of 1939. Printed and Published by A. L. Rhodes, Government Printer, Trinidad and Tobago. Price 72 cents.

A summary of the progress made in the petroleum, asphalt, and quarry industries during 1938. The production of crude oil, number of wells drilled, refinery operations, pipe-lines laid down, tank-storage capacity, and exports of petroleum and its products from the islands are all given. Statistics relating to the industries are given in several tables, and there is a detailed account of the petroleum industry in Appendix B. There are also eight graphs comparing the present position (1938) with past years as far back as 1911, and in one case 1890.

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Geology.

994. Travis Peak Formation of Central Texas. R. H. Cuyler. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 625–642.—The Travis Peak is the lowest formation in the Trinity Group in Central Texas. At the type locality in Travis Co., it consists of three members: the lower (Sycamore) consisting essentially of conglomerates and sands, the middle (Cow Creek) of limestones, and the upper (Hensell) of sands and marls. The formation has a total thickness of 263 ft., although this varies according to the locality. The general character, however, of the various phases in the different localities is the same, and their relationship is shown in a vertical section and table.

The Cow Creek beds are distinguishable from those in other parts of the formation by their lithologic characters and abundant fossils, the fauna of the Travis Peak, in fact, being mainly restricted to the Cow Creek.

Reference is made to the Glen Rose–Travis Peak contact, which, owing to similarity in lithologic character, causes much difficulty in differentiating the formations. It has been defined by R. T. Hill that the "lowest appearance of the peculiar fossils

Monopleura and *Requienia* indicates the beginning of the Glen Rose formation." Collections made by the author from various outcrops of the Travis Peak formation show that in many places this definition is reliable. G. S. S.

995. Sub-surface Study of Greenwich Pool, Sedgwick County, Kansas. A. S. Bunte. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 643–662.—The Greenwich Pool, comprising parts of Sections 10, 11, 14, 15, and 22 of T. 26 S., R.2 E., Sedgwick Co., Kansas, is located on an anticlinal ridge parallel with the Nemaha buried mountains. The structure was discovered by the Shell Petroleum Corporation in 1925 by core-drill exploration.

Although the Permian and Pennsylvanian systems are present, they have no economic bearing and are not discussed. It is from the Mississippian and the upper part of the Ordovician that the producing zones of the field occur. Late in Mississippian times the area was uplifted and folding took place, followed by a cycle of erosion. Thus, the Mississippian and older formations unconformably underlie the Pennsylvanian.

The Mississippian Limestone, varying in thickness from 208 to 266 ft., is characterized in the uppermost 150 ft. by the presence of large amounts of chert associated with limestone. Within this cherty portion porous zones occur, forming good reservoirs for oil and water. This formation is followed by the Kinderhook Shale.

Underlying the Kinderhook unconformably is the Viola Limestone (Ordovician) This has an average thickness of about 40 ft. and in its uppermost part is very porous, constituting an excellent reservoir for oil.

The Simpson formation, about 125 ft. thick and underlying unconformably the Viola Limestone, consists of sand with small amounts of green shale. Near the base a petroliferous zone occurs.

Production.—The Viola Limestone is at present the main producing zone. It has yielded a total of about 6,504,319 brls., an average per acre of 15,125 brls., and an average per well of 144,540 brls.

Eight wells have been located and completed in the Simpson formation, and to date have produced a total of 316,646 brls. of oil, an average recovery per well of 39,580 brls. G. S. S.

996. Wildcat Drilling in 1938. F. H. Lahee. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 789–794.—In this paper a review is given of wildcat drilling for the year 1938. Figures are supplied for the Gulf Coastal Plain States and for the whole United States with the exception of Ohio and more eastern States from which information has not been received.

A steady increase is revealed both in number of wildcat wells drilled and in the average depth of hole. Questions are raised on the control and effects of further discovery of new pools in the future. G. S. S.

997. Wildcat Activity in Kansas, 1938. E. A. Koester. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 795–796.—This is a very brief account of wildcat activity in Kansas during 1938. A table is given classifying all wildcat wells according to method of location. Economic conditions have tended to diminish wildcatting in recent years. G. S. S.

998. Developments in Kansas, 1938. R. G. Moss. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 797–806.—A brief summary is given of oil and gas developments in Kansas during 1938, reference being made to the leasing activity and geological work completed.

Drilling activity fell about 41% (1100 wells) below that of the previous year although, despite this, a number of new pools were discovered and two new counties were added to the producing list. The Morel Pool (Graham Co.) was probably the most important discovery, and this extended the general producing area of western Kansas nearly 15 miles north-west.

Of extensions to old pools, the most active development took place in the Zenith Pool. This had nearly 100 wells drilled in it and the area extended a mile north and 1½ miles east. The December runs were 74,168 brls., and on 1st January, 1939, the pool potential was 208,238 brls.

Towards the close of the year a very active leasing campaign was going forward in North-east Kansas and adjoining parts of Missouri and Nebraska (Forest City basin). G. S. S.

999. Recent Development in Illinois, with Discussion of Producing Formations below McClosky "Sand." A. H. Bell and G. V. Cohee. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 807–822.—From March 1938 to March 1939 the rate of oil production in Illinois has increased rapidly from a daily average of 43,000 brls. to 160,000. This increase has arisen almost wholly owing to development on the western side of the Illinois basin, production originating from sandstones in the lower part of the Chester series (Upper Mississippian). A recent discovery of oil in Devonian limestone in the old Sandoval field (Marion Co.) may have an important bearing on future development.

A discussion of developments during the twelve-month period is included in the paper, together with a review of the known occurrences of oil in Illinois below the McClosky formation. Tables are given of the producing formations in Illinois and approximate depths to principal producing horizons in the oil-fields. G. S. S.

1000. Developments in Oklahoma during 1938. E. F. Shea. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 823–835.—Activity in all branches of the oil industry in Oklahoma showed a marked decrease during 1938. Total oil production was approximately 170,000,000 brls., representing a decrease of 50,000,000 brls., or more than 23% from the total of 1937. The Oklahoma City and Fitts Pools continued to lead the State output with an annual production of 38,796,000 and 16,655,000 brls., respectively.

Seismograph work was again the chief exploratory means used in the quest for new structures, although a reduction of 20% was shown in the average number of crews as compared with 1937.

Very slight decrease occurred in wildcat drilling. Of the 2000 well completions, 220 (11%) might be classed as exploratory wells, and the great majority of these were situated close to producing pools in the central part of the State. Resulting from the drilling of the 220 wells, forty-two new producing areas or extensions to old producing areas were discovered, and of these sixteen might be considered as extensions to known pools and twenty-six as new pools. Thirty-nine of the discovered wells produced oil and three produced gas. Pennsylvanian sediments accounted for production in nineteen discovery areas, Ordovician in nineteen wells, and Siluro-Devonian in four wells.

In his conclusions the author states that much untested territory still remains within the State in which new pools undoubtedly await discovery.

Tables of discoveries in Oklahoma during 1938 and a map showing location of new pools and the more interesting wildcat wells accompany the paper. G. S. S.

1001. Developments in West Texas and South-eastern New Mexico during 1938. H. P. Bybee, B. R. Haigh, and S. J. Taylor. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 836–843.—Drilling operations in South-eastern New Mexico and West Texas during 1938 were 21·2% less than in 1937. South-eastern New Mexico had 16·2% less operations of all classes, but had 53·3% more wildcats and outposts, which were responsible for many extensions of existing fields, although they included only two new discoveries. West Texas had 22·5% less operations, but had 15·7% more wildcats, with results almost identical with conditions in New Mexico. Of sixty-six wildcats in New Mexico, twenty-four were completed as oil wells and one as a gas well; whilst of 192 wildcats in West Texas, forty-six produced oil wells and three gas wells.

Much geophysical prospecting and core drilling were done, particularly in New Mexico, where the work was more extensive during 1938 than in any previous year. Twenty-seven core tests were recorded.

Drilling and production figures for the two areas are tabulated. G. S. S.

1002. Developments in North-Central and West-Central Texas, 1938. J. J. Maucini. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 844–859.—Developments and discoveries in

1938, which showed a considerable advance in these areas, have greatly increased the importance of the Strawn formations as a major producer. Similarly, the Bend, Canyon, and Cisco series have contributed very largely towards the activities of the region.

Bend Formation.—Although practically all wells drilled sufficiently deep to test beds have yielded showings of oil, no production of economic importance has so far been developed in this series north of Young County.

Strawn Formation.—The chief discovery in this series was the Hull-Silk Pool in North Archer County. Of much importance, also, was the completion of the Adams Oil Co. Moer No. 1 well. This was completed from the Finley Sand (13 miles south-east of the Hull-Silk pool) and gauged 86 brls. in 18 hours.

Canyon Formation.—Important discoveries were made in Wichita and Archer Counties in the Holliday Pool, near Holliday, and in the King-Castlebury Pool, Wilbarger County. In the west-central district the most important new developments in the Canyon were in the Griffin Pool in Jones County, and in the McMillan Pool, Haskell County. The latter production area is expected to be confined to about 40 acres with a recovery of 2000 brls. per acre.

Cisco Formation.—A large number of pools were brought in from these beds during 1938. The most significant probably was the discovery of production in several new pools in Jones County from the Swastika Sand, notably the Chittenden, Irvin, and Noodle Creek Pools.

Extensions of much consequence were made east and west of the K.M.A. field. Prior to 1938, eighty-nine wells had been completed in the field of approximately 10,000 acres. At the close of 1938, 890 wells had been completed and the field extended east, west, and south to include approximately 32,000 acres.

Despite larger new production in 1938, the total production was slightly less than that in 1937—viz. 309,599 brls. This result was attributed to the drastic proration conditions which ruled during 1938. G. S. S.

1003. Developments in South Texas, 1938–1939. G. Kidd. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 860–870.—During the year forty fields were discovered in South Texas, and their geographic positions are shown on a map. In addition, fifty-eight new sands were proved for production. This record is surpassed only by the year 1937–1938, and exceeds the records of other years both in number of discoveries and in probable additions to reserves.

Of outstanding importance was the development of large production from the Frio-Vicksburg. From this sand group were proved the major oil-producing zones in the district, and of the discoveries eight fields and twenty-seven sands were from this zone. The new fields are Alice, East Alice, La Gloria, Blucher, Kelsey, La Reforma, Sun, and McAllen.

In the coastal area the new Frio fields are: Cordele and Francitas (Jackson Co.), Bonnieview, La Rosa and Melon Creek (Refugio Co.), and Riverside (Nueces Co.). As a group these fields constitute probably the year's greatest contribution to South Texas reserves. G. S. S.

1004. Development in East Texas during 1938. E. A. Wendlandt and G. W. Pirtle. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 889–895.—The East Texas district, as here discussed, comprises forty-four counties in the north-east of the State, and covers an area of about 37,000 sq. miles.

Discoveries included two oil-producing areas, two gas and distillate areas, and oil production in two old gas-fields. A total of 2213 wells were drilled during the year.

Although a number of completions were made in the district, these decreased by about 35 — during 1938 as compared with the preceding year.

Considerable exploratory drilling was directed to the Paluxy, lower Glen Rose, and Travis Peak series (Lower Cretaceous). G. S. S.

1005. Progress of "D'Arcy Exploration's" British Oil Search. Anon. *Petrol. Times*, 15.7.39, **42**, 76.—Eakring No. 1 well found good-quality crude in June at a

depth of 1914 ft., and during the first week gave 107 tons by bailing. The well was deepened to 1978 ft. to determine the full extent of the sand. At Formby, Lancashire, seven of the shallow geological bores are capable of producing oil from depths of 100–150 ft. The oil is of good quality and three of the wells have given some 70 tons of oil. This is seepage oil, and geophysical work will be undertaken before deciding on further drilling.

The Hardstoft well is giving two tons of oil/day after cleaning and acid treatment. Some 300 tons of oil have been recovered in nine months as compared with 29 tons in 1937. Cousland No. 2 was completed at 2432 ft. on encountering water, and will be used as an observation well. Eskdale No. 2 found a considerable gas yield at 4212 ft., and has entered salt and anhydrite which probably caps the Permian.

G. D. H.

1006. Earthquakes and Petroleum Deposits. E. Fossa-Mancini. *Bol. Inform. Petroleras*, April 1939, **16** (176), 23–50.—Examination of the effects that may be looked for in petroleum deposits, due to seismic disturbances in neighbouring regions. One of the conclusions arrived at is that owing to the contraction and expansion of the rock the globules of oil tend to collect and to become separated from the water, so that in this respect the seismic action may be beneficial, whilst, on the other hand, damage may be suffered by displacements in wells, fracture of pipe-lines, and disturbance of plant erected at the surface. A very complete bibliography is attached.

H. I. L.

1007. Petroleum in Peru. Jochamowits. *Bol. Inform. Petrolas*, May 1939, **16** (177), 71–76.—This is a consideration from the geological point of view of the extensive possibilities existing in Peru for obtaining petroleum, many of which have not as yet been touched, whilst others have been only superficially explored. H. I. L.

1008. Geological Structure of the Styria Basin and the Question of its Oil Prospects. A. W. Hermaden. *Petrol. Z.*, 1939, **35**, 389–397.—A detailed description of the geological structure of the territory concerned is given. The prospects of finding oil are considered to be doubtful, although it is possible that oil deposits may exist in the southern part of the basin. No drilling has been started up till now. E. W. S.

Geophysics.

1009. Developments and Trends in Geophysical Petroleum Prospecting. Anon. *Petrol. Engr*, Midyear 1939, **10** (10), 72, 74, 76.—There has been a definite shift in the past year in reconnaissance work from the reflection seismograph and torsion balance to the use of the gravimeter, and soil and soil-gas analysis. The use of the refraction seismograph has been virtually discontinued.

The Eola type of structure, with its small amount of reversal and prevalence of faults, has made correlation methods indispensable, and this has led to improvements in reflection instruments. These have permitted the working of the Sparta–Wilcox trend area, which was hitherto thought too difficult for the reflection method.

The number of operating seismograph crews has decreased, whilst the gravimeter parties have increased from 24 to about 60. G. D. H.

1010. Progress and Trends in Geochemical Methods of Prospecting. J. B. Eby. *Petrol. Engr*, Midyear 1939, **10** (10), 78, 80, 82.—The geochemical exploration process is designed primarily to find oil or gas in place. A shallow surface specimen of soil is taken for wax analysis and a deeper specimen from a depth of about 8 ft. for ethane determination. After the wax and gas analyses, the data are plotted on maps. At West Saxet the data indicated two oil horizons, and this indication was later confirmed.

Soil surveys are being made in various parts of U.S.A., in Venezuela, and in Russia. It is believed that soil analysis has excellent possibilities of becoming a successful and recognized method of exploration, but it is as yet impossible to state just what the future holds for it. G. D. H.

Aerial Survey.

1011. Recent Developments in Technique of Aerial Photography. H. T. Bruce. *Petrol. Engr*, May 1939, **10** (8), 31–32; June 1939, **10** (9), 141–142.—To-day aerial cameras are available with lenses capable of producing reconnaissance and survey maps with contour intervals as close as 5 ft. Multi-lens cameras have now become standard for most types of vertical photographic work, and to fill in the blanks of the Maltese Cross print so produced, two five-lens cameras have been mounted side by side with one turned through 45° about a vertical axis. They are operated together.

Planes of special types are required. The average working altitude is 15,000–25,000 ft. The solar navigator has greatly facilitated work in territory for which no maps exist. It automatically solves the problem of varying winds and drifts, and a predetermined course can be followed with an accuracy of 0·25°. This triangulation flight lines can be made.

The details of an aerial survey are briefly described.

By means of the stereoplanigraph, precise contour maps can be drawn. The map scales have ranged 2 ft./in. to 2 ml./in. Under most conditions contour maps can be made by this method more economically than by conventional ground survey, and to the same or even to a greater degree of accuracy.

Costs depend on individual conditions; the type of plane, weather, scale. Some government maps have cost as little as $4/sq. ml. at 2 in./ml. In many instances aerial survey costs have been lower than those of ground surveys. G. D. H.

Drilling.

1012. Use of Water with High Salt Content for the Preparation of Cement Slurry. I. V. Visotski. *Neft. Khoz.*, April–May, 1939, **20** (4–5), 53–55.—At many points of the Russian steppes, owing to lack of ordinary water for the preparation of cement slurry, salt water has been used. This has been the case especially in the Ural–Emba region, where since 1930 for cementing, water with 18–19° Bé salt content, and later even more salty water (up to 25° Bé), were employed.

The properties of cement slurry prepared with water of varying salt contents were examined, and the effect of the addition of varying proportions of calcium chloride has been studied.

Results of tests were satisfactory. Minimum setting and hardening times were obtained with water which had been diluted to a 10° Bé salt content. Such salt water accelerates setting, and may therefore replace fresh water containing accelerators. Addition of $CaCl_2$ to this 10° Bé water still further improves the quality of the cement, so that it approaches the standard for plugging-back operations. L. R.

1013. Skidding Derricks by Means of the Draw-Works and the Electric Motor of the Drilling Rig. G. V. Drogalin. *Neft. Khoz.*, March 1939, **20** (3), 13–16.—In Sula-Tepe sixteen wells had to be drilled by means of three derricks within half a year. The distance between locations being 100 m., pumping aggregates could be placed between two wells, serving both without moving. The derricks had to be skidded over special wooden substructures, owing to the mountainous ground, and the pulling power was supplied by the motor of the drilling rig. Details of skidding procedure and organization of work are given.

It is concluded that the method of skidding derricks employed has the following advantages:

It eliminates dismantling and assembling the equipment; it sets tractors free and eliminates waiting time for tractors;

The movement of the derrick is smoother and more uniform than with tractors;

There is a considerable economy in time and better use is made of derricks and drilling equipment;

Cost of rigging-up well equipment is considerably reduced. L. R.

1014. Diesel Engine as used for Drilling. A. D. Luco. *Bol. Inform. Petrolas*, April 1939, **16** (176), 17–21.—Describes the advantages of diesel engines over steam for

operating rotary drills and the auxiliary mechanisms which are necessary in order to overcome the inherent lack of flexibility which characterizes any diesel or I.C. engine as compared with the simplicity, robustness, flexibility, and ease of handling provided by steam plant. H. I. L.

1015. "Directed" Borings. J. Opes. *Bol. Inform. Petrolas*, April 1939, **16** (176), 56–66.—Description of methods adopted and tools used for deviating the boring from the line it would follow by ordinary methods of vertical drilling. Particulars given are taken from operations which were carried out with success at Comodoro Rivadavia. H. I. L.

Transport and Storage.

1016. Launching Submarine Pipe-line at Caleta Cordova, for Loading Tankers. L. Aguirre. *Bol. Inform. Petrolas*, May 1939, **16** (177), 14–32.—Describes construction and laying of two pipe-lines, 1–12 in. and 1–8 in. from the pumping-section near the shore to a dolphin placed adjacent to the anchorage for the tankers, the latter being connected by means of flexible pipes coupled to the fixed pipes terminating at the dolphin. The construction is fully illustrated. H. I. L.

Crude Petroleum.

1017. Patent on Crude Oil. W. W. Ledbetter. U.S.P. 2,162,281, 13.6.39. Appl. 8.7.36. Method of separating oil from water by introducing the oil at the base of a confined column of salt water and allowing it to rise while stirring. The accumulated oil above the column is then withdrawn. W. S. E. C.

Cracking.

1018. Patents on Cracking. E. J. Houdry. U.S.P. 2,161,676, 6.6.39. Appl. 8.11.35. Process for the catalytic conversion of hydrocarbons boiling above the gasoline range into high anti-knock fuels, including gasoline. The hydrocarbons are treated with adsorptive silicious contact materials or catalysts in recurring cycles.

J. C. Bolinger, W. A. Howard, and P. Woolley. U.S.P. 2,162,933, 20.6.39. Appl. 23.8.37. Protection of condenser tubes in cracking tube-stills against corrosion or salt deposition by injecting ammonia into the oil-distillation system. The salts are removed by introducing liquid water in the vapour line just ahead of the heat exchanger or condenser into which it discharges.

S. A. Guerrieri. U.S.P. 2,163,170, 20.6.39. Appl. 21.12.35. Vapour-phase cracking of hydrocarbon gases and vapours in the presence of molten metal. W. S. E. C.

Polymerization.

1019. Patents on Polymerization. D. R. Stevens and W. A. Gruse. U.S.P. 2,161,392, 6.6.39. Appl. 3.11.36. Polymerization of normally gaseous olefines by subjecting them to the action of a mixture of 3% concentrated sulphuric acid and 97% of *ortho*-phosphoric acid at 100–250° C.

B. J. Flock and E. F. Nelson. U.S.P. 2,163,275, 20.6.39. Appl. 14.8.36. Stabilizing cracked hydrocarbon distillates to remove normally gaseous hydrocarbons by partly liquefying the gases under pressure to produce a liquid phase of relatively high olefine content and a gaseous phase of lower olefine content. The liquid-phase material is then supplied without lowering the pressure to a zone where it is polymerized, using a catalyst in the absence of the gas phase. The gaseous phase is supplied to a second polymerizing zone, which is maintained under a lower pressure than that of the first zone, and is polymerized in the vapour phase.

W. E. Kuhn. U.S.P. 2,164,293, 27.6.39. Appl. 13.3.37. Conversion of hydrocarbon oils and gases into gasoline by a combination gas polymerization and oil-cracking process. W. S. E. C.

Synthetic Products.

1020. Production of Gases for Synthesis. W. Held. *Petrol. Z.*, 1939, **35**, 435–437.—The author gives a short critical account of the methods used to-day for the production of hydrogen in Germany from lignite, lignite briquettes, and different forms of coal. In U.S.A. part of the hydrogen is made from hydrocarbon gases, a method which may be of some interest for Germany in connection with the by-products of the synthesis itself. All the big manufacturers in Germany, like Krupp, Bamag- Meguin, Pintsch, and others, have now developed plants for the production of mixtures of nitrogen and hydrogen or hydrogen and carbon monoxide in the right proportion ready to use for synthesis. E. W. S.

1021. Production of Hydrocarbons. W. Held. *Petrol. Z.*, 1939, **35**, 493–495.—Figures are given regarding the requirements of German plants for the production of synthetic hydrocarbons and methanol. Data concerning quantities of hydrogen and metals for furnaces and containers are also given. E. W. S.

Refining and Refinery Plant.

1022. Cresol as Lubricating Oil-Refining Solvent and its Use in S.N.P. Process. H. Suida and H. Poell. *IIme Congrès Mond. Pétrole*, **2** (Sect. 2), 807–821.—Nomenclature of solvent extraction is critically examined and the terms "solvent raffinate" and "solvent extract" are adopted.

The use of anhydrous cresol as a solvent is discussed and its selectivity compared with those of nitrobenzene and phenol. It is shown that cresol is superior to all other solvents except nitrobenzene. A two-stage extraction process is described in which the oil is extracted in the first stage with anhydrous cresol, and in the second stage the solvent extract is saturated with water yielding a raffinate of inferior quality to that of the raffinate from the first stage. The process is further improved by the addition of 15–35% of nitrobenzene to the cresol in the first stage. The lay-out and operation of a technical S.N.P. plant at Hamburg are described. W. P.

1023. Solvent Extraction of Lubricating Oils with Phenol. R. Navarre. *IIme Congrès Mond. Pétrole*, **2** (Sect. 2), 823–835.—The use of phenol as a solvent is discussed in relation to current practice. Operating temperatures have been reduced and the settling difficulties thereby introduced have been largely overcome by re-cycling and by the introduction of suitable temperature gradients throughout the process. Nevertheless, in spite of improvements in contacting and in separating, practical results remain considerably inferior to theoretical expectations.

The use of wet phenol has permitted extension of the process to the production of less highly refined oils and to the further fractionation of the solvent extract. W. P.

1024. Solvent Extraction of Columbian Distillates with Phenol. S. Hemmer and R. Gay. *IIme Congrès Mond. Pétrole*, **2** (Sect 2), 837–854.—Refining by solvent extraction depends on the coexistence of two liquid phases and the variations in the critical temperatures. The range of coexistence is found to be greater the more paraffinic is the oil and the higher its molecular weight. Miscibility curves are given for various oils in contact with anhydrous and with dry phenol. The author uses triangular diagrams showing equilibria between phenol-paraffinic hydrocarbons—naphthenic hydrocarbons—to explore the possibilities of phenol extraction for a given oil. W. P.

1025. New Methods of Oil Refining; Solvent Extraction with Phenol. F. Schick. *IIme Congrès Mond. Pétrole*, **2** (Sect 2), 855–862.—A solvent refining plant is described and analyses are given of the products derived from it. Phenol is used as the solvent, and the plant provides for continuous extraction and solvent recovery. W. P.

1026. Solvent Extraction. A. Klinkenberg. *IIme Congrès Mond. Pétrole*, **2** (Sect. 2), 863–869.—The author analyses the various extraction processes into their simplest forms. The extraction factor, E (the ratio of quantities of substance dissolved in the extract phase and the residual phase) is calculated for a variety of processes.
W. P.

1027. Fractionation of Heavy Oils by Solutions of Gases at Ordinary Temperature. M. M. Godlewitz and S. Pilat. *IIme Congrès Mond. Pétrole*, **2** (Sect 2), 883–886.—The complete fractionation of high-boiling, viscous lubricants can be effected at ordinary temperatures by the treatment of a solution of mineral oil in light hydrocarbons with gases under pressure (methane, natural gas, carbon dioxide, etc.). The introduction of the gas under pressure causes the separation of the heavier hydrocarbons as a second liquid phase. Those hydrocarbons will be separated which are themselves bad solvents for the gas employed. Methane is dissolved most in light hydrocarbons and least in high molecular paraffins and in aromatics. These latter will therefore separate out. Examples of the process are given.
W. P.

1028. Government Distillery at San Lorenzo. T. Tabanera. *Bol. Inform. Petroleras*, May 1939, **16** (177), 33–46.—Complete description of the lay-out, including power plant, tanks, pumps, stills, and electrical gear at the above refinery.
H. I. L.

1029. Recovery of Sulphur from Flue Gases. A. R. Powell. *Industr. Engng Chem.*, 1939, **31** (7), 789.—A description of the various commercial units at present in operation for the recovery of sulphur from flue gas.
H. E. T.

1030. Patents on Refining. M. T. Kendall. U.S.P. 2,161,580, 6.6.39. Appl. 16.10.36. Continuous process of neutralizing acid-treated hydrocarbon distillate by quickly suspending finely divided quick-lime in 200–400 parts by weight of water, and then immediately contacting the acid-treated cracked distillate with the suspension.
W. S. E. C.

Chemistry and Physics of Petroleum.

1031. Hydrogenation of Ethane on Cobalt Catalysts. E. H. Taylor and H. S. Taylor. *J. Amer. chem. Soc.*, 1939, **61**, 503–509.—The rate of the hydrogenation decomposition of ethane has been studied on a cobalt/thoria/copper/kieselguhr catalyst and on four cobalt/magnesia catalysts containing varying proportions of the components. The results indicate that for this reaction cobalt is less active than nickel, but much more active than copper. The cobalt/magnesia catalysts are much more active than the cobalt/thoria/copper catalysts, and over the range of compositions studied the activity of the catalysts of the cobalt/magnesia type increased with increasing cobalt content.

The results show that by the substitution of magnesia for thoria, the availability of cobalt for ethane hydrogenation is enhanced, so that the rate of reaction per gramme of cobalt is much greater with the cobalt/magnesia catalyst. On the other hand, this type of catalyst does not give such high yields of liquid product as the cobalt/thoria catalysts. It is concluded, therefore, that the thoria in the Fischer catalyst exerts a promoter action for catalyzing the polymerization of the hydrocarbon radicals to the desired products.
W. E. J. B.

1032. Polymethylbenzenes. XXIII. Preparation and Physical Properties of 3- and 5-Ethyl*pseudo*cumenes and of Ethylmesitylene. L. I. Smith and M. A. Kiess. *J. Amer. chem. Soc.*, 1939, **61**, 284–288.—The authors have prepared 3- and 5-ethyl*pseudo*-cumene and ethylmesitylene. The latter was prepared by conversion of bromo-mesitylene into the Grignard reagent and ethylation of the latter to yield the hydro-carbon in about 40% yield. It was also prepared by the conversion of mesitylene into acetomesitylene, followed by reduction of the ketone.

5-Ethyl*pseudo*cumene was prepared in a manner similar to that of ethylmesitylene. 3-Ethyl*pseudo*cumene, a new hydrocarbon, was prepared by converting 3-bromo-

*pseudo*cumene into the Grignard reagent, which was then ethylated. The structure of the latter has been proved and various derivatives have been described.

Physical properties of these hydrocarbons are noted below.

	Ethylmesitylene.	5-Ethyl*pseudo*-cumene.	3-Ethyl*pseudo*-cumene.
Boiling point, °C. . .	210 (725 mm.)	210 (725 mm.)	214 (725 mm.)
Freezing „ °C. . .	− 15·56	− 13·58	Liq. at − 50
n_D^{20}	1·5074	1·5075	1·5133
d_{20}^{20}	0·894	0·889	0·900

W. E. J. B.

1033. Vapour Phase Catalytic Conversion of Tertiary Butylmethyl Carbinol and Tertiary Butylethylene. P. L. Cramer and A. L. Glasebrook. *J. Amer. chem. Soc.*, 1939, **61**, 230–232.—A study has been made of the vapour-phase catalytic conversion of *t.*-butylmethylcarbinol and *t.*-butylethylene over activated alumina and anhydrous aluminium sulphate to yield the three isomeric hexenes, *t.*-butylethylene, *unsym.*-methyl*iso*propylethylene, and tetramethylethylene.

The experiments were carried out over the temperature range 275–390° C. in a Pyrex tube heated in the conventional type of electric furnace.

In contrast to results obtained by liquid phase reactions with acid catalysts, the dehydration of *t.*-butylmethyl carbinol over activated alumina yields *t.*-butylethylene rather than tetramethylethylene as the principal olefin. This reaction is largely independent of the reaction temperature.

In accord with results obtained in liquid-phase reactions with acid catalysts, tetramethylethylene is the principal olefin formed by the vapour-phase dehydration of *t.*-butylmethylcarbinol over anhydrous aluminium sulphate.

t.-Butylethylene was passed unchanged over alumina, whereas over aluminium sulphate the olefin is rearranged to give the same mixture of hexenes as obtained from *t.*-butylmethyl carbinol over the same catalyst. W. E. J. B.

Analysis and Testing.

1034. Modified Ostwald Viscometer for Routine Control Tests. Anon. *Nat. Petrol. News*, 14.6.39, **31** (24), R. 262.—The Zeitfuchs modification of the Ostwald viscometer has been further modified by the addition of a third tube in series with the tube bearing the capillary. The third tube joins the existing tube at a point at the bottom of the upper bulb and is connected, through a stop-cock, semi-permanently to a vacuum supply. The third tube is used for filling and cleaning operations, and is operated by closing the existing limb with the forefinger and opening the vacuum supply-line cock. H. G.

1035. The Critical Solution Temperature of Mineral Oils in Acetone. E. Vellinger. *II*me *Congrès Mond. Pétrole*, **2** (Sect. 2), 871–878.—The author discusses the use of Critical Solution Temperatures (C.S.T.), and describes his method of determination and his investigations with various solvents. Acetone was selected as the most serviceable solvent.

The origin of the crude has a negligible effect on the C.S.T. in comparison with that of method and degree of refining. Refining either with H_2SO_4 or earth elevates the C.S.T.; ageing, either artificially (oxygen at 110° C.) or in service (whether below or above 150° C.), has little effect on the C.S.T. in the case of normally refined oils, but causes an appreciable lowering of C.S.T. in the case of over-refined oils. This is attributed to the greater oxygen absorption of these latter. W. P.

1036. Analysis of Phases in an Extraction Process. A. Schaafsma. *II*me *Congrès Mond. Pétrole*, **2** (Sect. 2), 789–881.—The methods devised for the analysis of the phases in a counter-current extraction process are described.

Various methods of determining the solvent (furfural) and oil contents of the phase were investigated: (1) washing out solvent with alcohol; (2) evaporation of solvent at 195° C.; (3) measurement of dielectric constant. Method 3 was selected as most suitable for rapid analysis provided an analysis of the oil is not required.

The refractive indices of the solvent-free products were also determined in the case of Method 2. Raffinate yield can be calculated from a knowledge of the refractive indices of the base material, the raffinate, and the extract. Also, for a given base the refractive index of the raffinate is a measure of its quality. W. P.

Motor Fuels.

1037. Gum Formation in Alcohol-Gasoline Blends. D. A. Ilyin. *Neft. Khoz.*, March 1939, **20** (3), 50–52.—Cracked gasoline containing various percentages of absolute alcohol has been exposed for varying periods to 40° C. in the presence of steel, brass, and aluminium strips.

It has been found that the addition of alcohol definitely reduces gum formation in cracked gasoline. Gum formation is, however, accelerated by certain organic admixtures to alcohol, such as acetic acid and ethers, and by catalytic action of certain metals, especially brass. Addition of straight-run gasoline has a retarding effect.

Inhibiting agents which are normally used to stabilize cracked gasolines are not always effective with alcohol-gasoline blends. Optimum induction periods are obtained by addition of amino- and oxy-compounds. The stabilizing action of an inhibitor concentration of 0·01% lasts for considerable periods up to ½ year. The most effective inhibitor action is obtained with fresh gasolines. L. R.

1038. Ethyl Fluid Blending Chart for Motor-Method Octane Numbers. L. E. Hebl, T. B. Rendel, and F. L. Garton. *Industr. Engng chem.*, 1939, **31** (7), 862.—This chart is so constructed that when the octane number of a leaded gasoline is plotted against the amount of tetraethyl lead added, a straight line results. The effectiveness of tetraethyl lead in different fuels can thereby be readily compared in terms of the slope of the line obtained.

The method of construction employed in the chart illustrated generally follows that described by the authors in a previous paper on the subject with certain adjustments embodied which were made as a result of additional data since accumulated.

The factors influencing the octane number of a leaded gasoline and which are incorporated in the chart are recapitulated as follows:—

1. The effectiveness of *iso*-octane at different concentrations.
2. The effectiveness of tetraethyl lead at different concentrations.
3. The octane number of the base gasoline.
4. The lead susceptibility of the gasoline.
5. The concentration of tetraethyl lead added.

Following an outline of the method adopted in determining values used in constructing the chart the scales of which were based on the average of a large amount of data obtained co-operatively on groups of from 17 to 20 C.F.R. engines, the authors discuss the accuracy of the chart in relation to the different lead responses of certain engines. It is pointed out that data from abnormal engines will necessarily produce a deviation in the slope or a curvature of the line, but with an average engine an accuracy of ± 0·1 octane number can be obtained from the chart.

The usefulness of the chart is next shown when the lead susceptibilities of various blends of di*iso*propyl ether, *iso*octane and straight-run aviation gasoline, also of *iso*-octane with vapour-phase-cracked gasoline are shown graphically, and it is illustrated how widely the lead susceptibilities of certain materials may vary.

In conclusion a short description is given of a simpler graphical derivation of an ethyl blending chart. E. F. C.

1039. Factors in Knock Rating and Lead Susceptibility of Gasoline. F. G. Graves. *Industr. Engng Chem.*, 1939, **31** (7), 850.—This article presents a definite relation between octane number loss for cracked gasolines and their initial knock rating

the latter being dependent on the cracking stock origin. Composition and sulphur content of gasolines have been recognized as influencing the lead susceptibility. Employing a numerical expression for lead susceptibility developed by other investigators, relations between this characteristic and sulphur content are developed for straight-run and cracked gasolines as well as for aromatic stocks. This relation should be of some value in estimating the lead susceptibilities of various gasolines. Paraffin and naphthene hydrocarbons have the highest susceptibility. Although pure aromatics have a higher susceptibility than olefines, they are more sensitive to the effect of sulphur compounds. H. E. T.

1040. Patent on Motor Spirit. W. A. Schultze. U.S.P. 2,162,319, 13.6.39. Appl. 6.10.36. Refining cracked gasoline to reduce the sulphur content by treatment in the vapour-phase with bauxite at 500–750° F. W. S. E. C.

Lubricants.

1041. Patents on Lubricating Oil. J. M. Whiteley and H. C. Vesterdal. U.S.P. 2,160,930, 6.6.39. Appl. 23.3.35. Separation of wax from petrolatum by means of propane.

O. S. Pokorny. U.S.P. 2,160,985, 6.6.39. Appl. 3.2.37. Dewaxing hydrocarbon oil using a mixture of equal parts of methyl normal propyl ketone and methyl normal butyl ketone.

W. P. Gee and M. Neuhaus. U.S.P. 2,161,567, 6.6.39. Appl. 27.3.37. Solvent extraction of lubricating oil using furfural.

H. H. Gross. U.S.P. 2,161,569, 6.6.39. Appl. 19.2.38. Solvent dewaxing of lubricating oil using a mixture of methyl ethyl ketone and benzol.

W. B. Hendrey. U.S.P. 2,161,572, 6.6.39. Appl. 1.5.37. Solvent refining of hydrocarbon oil using a mixture of *ortho-* and *para*-chlorphenol containing 50–75% of the *para*-isomer together with a subsidiary solvent, *e.g.*, chloroform.

E. C. Knowles. U.S.P. 2,161,581, 6.6.39. Appl. 27.1.38. Dewaxing hydrocarbon oil by means of a small proportion of montan wax and cellulose stearate.

H. S. Holt. U.S.P. 2,161,625, 6.6.39. Appl. 14.1.38. Solvent extraction of lubricating oils using methyl ethyl ethynyl carbinol.

E. Terres, J. Moos, and E. Saegebarth. U.S.P. 2,161,753, 6.6.39. Appl. 22.3.35. Solvent extraction of hydrocarbon oils using tribromhydrins in admixture with an auxiliary solvent.

T. A. La Brecque. U.S.P. 2,161,964, 13.6.39. Appl. 10.7.34. Apparatus for use in reclaiming used lubricating oil.

B. S. Greenfelder and M. E. Spaght. U.S.P. 2,162,195, 13.6.39. Appl. 6.2.35. Refining of lubricating oil by contacting it with a gas containing free oxygen at 120–500° F. in the presence of hydrogen oxide for a sufficient time to convert a substantial portion of oil of relatively low viscosity index into oxidation products which are preferentially soluble in liquid solvents such as benzaldehyde, nitrobenzene, cresylic acid, phenol, etc.

E. Terres, J. Moos, and H. Ramser. U.S.P. 2,162,682, 13.6.39. Appl. 25.10.37. Solvent extraction and dewaxing of mineral oils by means of fluorinate aliphatic hydrocarbon compounds.

K. C. Lauglkin. U.S.P. 2,163,245, 20.6.39. Appl. 15.6.37. Solvent extraction of hydrocarbon oils by means of phenol and 5–20% by weight of free sulphur is digested with the oil at 250–400° F. for 2–6 hrs.

W. Schrauth. U.S.P. 2,163,563, 20.6.39. Appl. 15.2.36. Method of reclaiming lubricating oil. W. S. E. C.

Asphalt and Bitumen.

1042. Methods of Classification and Analysis of Asphalts. H. Suida and F. Motz. *Petrol. Z.*, 1939, **35**, 511–517.—The methods used in Germany to-day for the analysis of petroleum asphalts are all subject to objection. At the present time the methods of Maass and Poll, working with different solvents, fuller's earth, and coagulent agents, are the most widely used. The results are, however, not strictly reproducible, because the temperatures of solution and adsorption are not standardized and the solvents like standard gasoline, etc., are not absolutely identical in every case. In a new combined plant, the treatment with fuller's earth in a nitrogen atmosphere and the extraction with chloroform and pyridine are effected nearly automatically. The temperatures of adsorption and of extraction are low and kept within very narrow limits, the asphalt being decomposed into a petroleum portion, asphaltic resin, petroleum resin, and hard asphalt. The resulting hard asphalt contents, in spite of low temperatures in the pyridine extraction, are far lower than those stated in the analysis of the same asphalts with earlier methods. E. W. S.

Special Products.

1043. Qualities of Naturally Condensed Waxes from Crude Petroleum. E. Casimir and C. Creanga. *Petrol. Z.*, 1939, **35**, 511–517.—Waxes accumulating on the walls of pipe-lines, tanks, etc., containing Roumanian paraffin base crudes chiefly consist of hydrocarbons (77–96%), the remainder being resins, asphaltic matter, and contaminations. 21–48% of the hydrocarbons are higher hydrocarbons with a melting point of up to 91–92° C. They are scarcely soluble in gasoline, ether, and other organic solvents, readily dissolved in chloroform, and precipitated from the chloroform solution by rectified spirit at 20° C. These hydrocarbons form the hard ceresin. In addition, the waxes contain some 6–13% of other solid hydrocarbon of 57–60° C. melting point. This is the so-called soft ceresin, the rest being oils. As the hard ceresins contained in the waxes are very similar to those produced from ozokerite as far as gravity, microstructure, appearance, etc., are concerned, the waxes may be used as a raw material equivalent to ozokerite. E. W. S.

1044. Alkylation of Phenols. V. I. Isagulyants and P. P. Bagryantseva. *Neft. Khoz.*, February 1939, **20** (2), 36–41.—The following methods of synthesis of *para*-tertiary butylphenol under atmospheric pressure have been examined systematically : (*a*) The reaction of *iso*butyl alcohol with phenol in presence of anhydrous zinc chloride. (*b*) The reaction of *iso*butylene with phenol in the presence of zinc chloride and aluminium chloride. (*c*) The effect of tertiary butyl chloride and hydrochloric acid on the acceleration of the alkylating reaction.

Optimum conditions for the alkylating reaction have been established, and also the quantities of catalyst necessary.

A profitable procedure of obtaining *para*-tertiary butylphenol has been evolved in which the alkylation of phenol is carried out with *iso*butylene in the presence of a small quantity of anhydrous aluminium chloride under low pressure, giving a yield of 78% of theoretic. This yield can be slightly increased by reactivating the portion of phenol that has not taken part in the reaction. L. R.

Detonation and Engines.

1045. What About the Engine. A. Taub. *J. Soc. aut. Engrs*, 1939, **44**, 201–209.—The author contends that tank mileage depends on the ability to utilize lean mixtures, and thinks that American automobile engine designers will shortly be forced to give more attention to this problem, due to the imminence of increased fuel taxation. During the past year or two in England the author has been engaged on intensive research on this problem at Vauxhall Motors, and maintains that the shape of the combustion chamber as such does not effect the problem, except in so far as it tends to create "hot-spots," exhaust poisoned pockets, or too high a surface-to-volume ratio during the first two-thirds of the burning period. The effect of trapped exhaust

products, the use of wide-gap plugs and improved coils, corrected distribution from the carburettor proper, vacuum control of spark advance, and long reach plugs are discussed.

The method of forecasting engine roughness by the plaster-cast method is being used by Vauxhall Motors, and data are given of analyses of several types of cylinder head by this method. The Cossor Dodds Cathode-Ray Indicator has proved very useful in studying combustion, and photographic reproductions of oscillograms showing pressure-time, and " rate of charge " of pressure during combustion are given, which make it possible to determine the actual pressure at the instant of maximum rate of pressure rise or the pressures in terms of percentage of peak pressure at any point during the combustion period. C. H. S.

1046. Fuel-Economy Possibilities of Otto-Cycle Aircraft Engines. D. S. Hersey. *J. Soc. aut. Engrs*, 1939, **44**, 235–251.—Calculations based on tests with single-cylinder units operating at compression ratios between 6·5–1 and 8·2–1 show that under ideal conditions with a 10–1 compression ratio, and operating at optimum spark setting on non-detonating fuel, best economy indicated specific fuel consumption of 0·307 lb. per 1 H.P./Hr. could probably be expected, which at the peak full-throttle mechanical efficiency of 92·5% should give a brake specific fuel consumption of 0·332 lb. per B.H.P./hr.; an improvement of approximately 22% on the consumption now being obtained on engines of about 6·5–1 compression ratio operating at reduced spark advance settings.

The limiting factor is detonation and consideration of the factors affecting detonation shows that compression ratio, spark advance, mean effective pressure, intake charge temperature, cylinder operating temperature, and fuel-air ratio must be jointly considered to obtain the best compromise. The effect of these variables under high output and economy conditions are dealt with at length, together with the means adopted to eliminate detonation.

The author is of the opinion that fuel-economy improvements can probably be obtained in current engines with only relatively minor changes in construction or equipment, and without any corresponding reduction in take-off output. Such changes might include automatic spark advance control, lowering of mixture temperatures by intercooling or reducing as much as possible the tip speed of the supercharger impeller, and operation at lowest engine speed which will give the desired cruising power at full throttle or at the limiting mean effective pressure. It is suggested that full throttle at all cruising powers should be aimed at, the cruising output being controlled by varying engine speed. C. H. S.

1047. C.F.R. Research Methods of Test for Knock Characteristics of Motor Fuels. Anon. *J. Soc. aut. Engrs*, 1939, **44**, 277–280.—The original research method for motor-fuel testing in the C.F.R. engine was developed by the Co-operative Fuel Research Committee in 1932. Some of the details of test conditions were never clearly laid down, and when the motor method came into general use the old research method was used to a small extent only, except in Germany, where the newer method was never generally adopted.

In recent years it has become evident that a less severe method of test in addition to the motor method gives at least some indication of the probable behaviour of the more temperature sensitive fuels under road conditions in comparison with other fuels relative to the A.S.T.M. ratings.

For research purposes only the original research method has now been clearly defined and approved by the Committee.

The variations from the motor method are as follows :—

Speed.—600 r.p.m. ± 6 r.p.m.

Spark Advance.—Fixed at 13 degrees B.T.C. for all compression ratios.

Intake Air Temperature.—125° F. ± 2° F.

Standard knock intensity is that obtained with a blend by volume of 70% *iso*-octane 30% normal pentane under standard operating conditions at a compression ratio of 5·75–1 and a barometric pressure of 760 mm. Hg.

Compression Pressure.—At a compression ratio of 5·75–1 corrected for baro-

metric pressure of 760 mm. Hg. the compression pressure shall be 130 lb. per sq. in. gauge, and at a corrected compression ratio of 6·7–1 it shall be 160 lb. per sq. in. gauge. C. H. S.

1048. Filtering Fallacies. A. M. Wolf. *J. Soc. aut. Engrs*, 1939, **44**, 259–270.—This paper, although it does not seek to belittle the usefulness of oil filters or to discourage their use, nevertheless points out that users who imagine that the use of such equipment as fitted to present-day engines solves their lubrication problems are liable to get a rude shock. The author is of the opinion that very much more care should be exercised when locating the filter, which should be built in rather than tacked on to the engine, which practice in many cases leads to trouble. A high mounting is desirable, to ensure draining of the return line after the engine has stopped and to minimize the amount of chilled oil left in the filter. Shortcomings of filters are enumerated to form a basis of a true analysis of their intrinsic worth. Operating conditions which may vary from "stop and start" work in low temperatures to continuous high-temperature operation may in the first case cause the filter to become inoperative, due to lack of heat, and the other extreme may produce oxidation product sufficient to arrest its functioning.

Many other aspects of the problem are dealt with, including types of filtering media, frequency of cleaning and replacing elements, moisture accumulation, and the merits of mechanical versus chemical filters. Data are presented on examination of crankcase oils from a large number of cars and trucks, some fitted with and some without filters, and the oil-flow characteristics of several filters as affected by grade of oil and operating temperature and pressures. The paper also touches upon the question of the removal of additives by filters and experiences with oil filters in aircraft practice. C. H. S.

1049. Comparison of Diesel and I.C. Engines. A. D. Luco. *Bol. Inform. Petrolas*, April 1939, **16** (176), 9–16.—Full technical exposition of the higher efficiency of the diesel engine, with particulars of tests and a list of applications in order of merit. H. I. L.

1050. Diesel Motor Coaches on the State Railways (Argentine). Anon. *Bol. Inform. Petrolas*, April 1939, **16** (176), 3.—The great increase in speed of which the diesel-driven trains are capable has resulted in an average time saving of 50% and the elimination of sleepers on many trains. Both fuel and lubricants are indigenous products. H. I. L.

Economics and Statistics.

1051. Relation between Crude Oil and Product Prices. S. A. Swensrud. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 765–788.—The relation between crude oil and refined product prices has long been a source of discussion within the petroleum industry, and particularly since the inauguration of proration.

Two main questions arise: (1) the fact as to the relationship existing periodically between the price of crude oil and the value of refined products they produce, (2) the sequence in crude oil and product price movements.

A study has been made during the years 1920–1939 and data are now presented in tabular form showing how the value of products, price of crude, and the refiner's margin have varied periodically during this time.

The market value of the refined products is shown to have declined considerably more than the raw material itself. Since the beginning of 1927 the wholesale value of the refined products from a barrel of crude declined by an average of $1·26 a barrel as compared with the years between 1920 and 1927. Similarly, the price of crude declined by an average of 92 cents a barrel. Thus it is clear that a considerable change has taken place during the period of study in the price relationship between crude oil and refined products. Since 1927, for example, the products of a barrel of crude have decreased by 34 cents a barrel more than has the posted price of the raw material from which they are obtained. It should be remembered, however, that with the

increased yield and quality of gasoline the products of a barrel of crude are now relatively a more valuable combination needing additional refining operations than the combination of products made in the early years of the study period.

The industry has in recent years maintained greater stability in the general range of crude oil prices, although it would appear the lag of downward movements acts to the detriment of the refining industry. Moreover, since State proration became customary about 1930, this lag has been more pronounced. It would seem to be better to have crude prices rely more directly upon product prices.

An appendix to the paper contains a full compilation of price data from 1920–1938 inclusive. G. S. S.

1052. Production and Export of Petroleum for Ecuador—1938.—Director General of Mining and Petroleum Production Ecuador. *Bol. Inform. Petroleras*, April 1939, **16** (176), 82–83.—Complete statistics are given, showing a nett production of petroleum of 358 cu. m. and of gasoline from natural gas of 6245 cu. m. Practically all the petroleum was exported and of the gasoline nearly one third went to Great Britain. H. I. L.

1053. Completion of the New Petroleum Laws in Brazil. J. A. Celiz. *Bol. Inform. Petroleras*, May 1939, **16** (177), 68–70.—Commentary on the new laws introduced in Brazil for protection of the petroleum industry. H. I. L.

1054. Convention between Bolivia and Paraguay Concerning the Supply of Petroleum. Anon. *Bol. Inform. Petroleras*, May 1939, **16** (177), 64–67.—Text of an agreement between Bolivia and Paraguay for the establishment of a pipe-line in El Chaco together with distilleries on the River Paraguay. Agreement dated 21st April, 1939. This agreement gives the Y.P.F.B. the exclusive right for 30 years, to distil crude oils produced in Bolivia, Paraguay, or elsewhere, on behalf of the Government of Paraguay. At the end of this period the whole installation shall be handed over to the Government of Paraguay at a valuation to be made at the time of handing over. H. I. L.

1055. World Legislation with Respect to Petroleum. (Cont.) Y. P. F. Librarian. *Bol. Inform. Petroleras*, April, 1939, **16** (176), 67–78; May 1939, **16** (177), 59–63.—These useful extracts of mining laws and bibliography are continued from *Bol. Inform. Petroleras*, No. 174. H. I. L.

BOOKS AND PUBLICATIONS RECEIVED

Automobile Facts and Figures. Twenty-First Edition. Pp. 96. Automobile Manufacturers Association, Inc. New York.

This is the twenty-first consecutive issue of the annual statistical review of the automobile industry, comprising numerous statistics relating to every aspect of the trade. Although production and sales of motor vehicles declined in 1938, the use of highway transport facilities continued near the 1937 peak.

Report on the Geology of the Superficial and Coastal Deposits of British Guiana. By D. R. Grantham and R. F. Noel-Paton. Pp. 122. 9 maps in folder. Geological Survey of British Guiana. The Argosy Co., Ltd., Georgetown, Demerara. 1938. Price $1.

A critical examination is given of a series of well samples and records resulting from the drilling of some eighty water-wells along the coastal belt of British Guiana and the bearing of the investigation on the possibility of the occurrence of petroleum is discussed. The evidence of the wells appears to provide no direct indication of the presence of petroleum. Reference, however, is made to the possibility of a rock floor 3000 ft. and upwards below the surface in the area between New Amsterdam and the Courantyne River. In this case the presence of Tertiary beds older than Pliocene in age may be inferred with the concomitant possibility of the presence of petroleum.

It is considered that the next step should be the establishment, by geophysical methods, of the depth of the rock floor in the Berbice–Courantyne district, to determine whether there is room for the inferred older Tertiaries.

The Birth of the Oil Industry. By Paul H. Giddens. Pp. 216. Macmillan Company, London. Price 14*s*.

This book represents a comprehensive narrative of the origin and development of the petroleum industry in Western Pennsylvania up to 1870. Based on fresh sources of information (many of which may be found in the collection at the Museum of the Drake Well Memorial Park near Titusville), it represents a vivid and concise account of the early years of speculation and struggle. Individual chapters deal with the great flowing wells of 1861–1864; methods of transporting the oil to market; development of markets; establishment of refineries; federal taxation; the rise and decline of oil towns; the battles between teamsters and oil men following the laying of the first pipe-lines; the depression years of 1867 and 1868; the formation of oil rings and exchanges. The book is written in an interesting, flowing style, and is a blend of drama and accurate documentation.

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Geology.

1056. Concentrations of Hydrocarbons in the Earth. E. McDermott. *Geophys.*, 1939, **4** (3), 195–209.—Investigations on the concentrations of hydrocarbons and minerals near the surface of the earth, and evidence of the presence of unsaturated hydrocarbons such as ethylene in the soil in appreciable quantities, have led to a new hypothesis for the origin and accumulation of petroleum. The main points of this hypothesis are the following. Genetically, the subsurface concentrations and the near-surface concentrations are very much the same. Oil shales are included in this category. The source materials of oil- and gas-fields are hydrocarbon gases leaking from the basement complex and from buried coal deposits. The saturated hydrocarbons result in gas-fields, whereas the unsaturateds are synthesized or polymerized to form oil which results in oil-fields. These gases migrate mainly in a vertical direction. There is no great movement of oil in the original accumulation. The formation of an oil- or gas-field depends principally on the permeability of the cap-rock and perhaps also to a more limited extent on the presence of certain catalysts such as aluminium chloride. As the permeability of shale decreases with depth of burial and in regions of deformation, the volatility of the accumulations will increase. The gases, during migration to the surface, transport quantities of the subsurface waters and the minerals dissolved in those waters.

The evidence for this hypothesis is discussed and its importance in relation to geochemical prospecting is indicated. S. E. C.

1057. The Formation of the S. Hanover Petroleum Deposits. L. Riedel. *Oel u. Kohle*, 1938, **14** (46), 963–967.—Geological evidence concerning the movement of the Hänigsen–Wathlingen salt-stock leads to the conclusion that the Nienhagen oil deposits could not have formed before the time of the *mucronaten* zone of the Senonian. This agrees with Barsch's mechanical conception of the formation of oil deposits which postulates that migration from the primary deposits first becomes possible when the salt in the neighbourhood of the salt-stock has been completely squeezed out from the parent salt-bed. In the case of the Hänigsen–Wathlingen salt-stock this event probably took place during the energetic salt movements in the Lower *mucronaten* Senonian. The importance of cracks and fissures distant from the salt-stock is pointed out. The presence of oil at a distance from the salt mass and yet in strata which extend up to it is explained by migration up these distant channels. S. E. C.

1058. Form and Tectonic Movements of the Lower Saxon Basin. G. Richter. *Oel. u. Kohle*, 1938, **14** (46), 968—976.—The study of numerous new borings shows that in the south the Lower Saxon Basin has a somewhat blurred form rather than a clear boundary. In the north it is outlined by an uplifted area, the "Niederdeutsche Masse." The area in which Lower Saxon sedimentation took place has the form of a trough-shaped geosyncline within which are zones favourable to sinking (Minden, Hils, Brunswick) and zones which are more stable (particularly the Nienhagen–Hildesheim ridge). In direction and tectonic tendency these elements are only preliminary to the present structure. The great graben system, and also the lines of weakness along which salt uplift took place, are the orogenic end stages of long-reaching epeirogenic demands. S. E. C.

1059. Helium Occurrences and their Accompanying Geological and Physical Conditions. A. Mayer-Gür. *Oel u. Kohle*, 1938, **14** (46), 977–983.—The world's resources of helium are reviewed. The more important occurrences are in Texas, Oklahoma, Ohio, Utah, Wyoming, Colorado, Montana, California, Alberta, Ontario, Russia, and Italy. These deposits are derived from the breakdown of radio-active minerals which are sufficiently widespread in the earth's crust to provide the quantities of helium at present known. Natural gas is of importance in that it assists or makes possible the escape of the occluded helium from the minerals. The conditions necessary for the formation of a commercial deposit of helium are a local enrichment of radio-active minerals in ridges of the basement complex or in sediments, and a suitable reservoir rock and structure for its accumulation, as well as a competent cap-rock and the presence of natural gas. A further favourable condition is the disruption, by tectonic forces, of the rocks containing the radio-active minerals. S. E. C.

1060. New Mathematical and Stereographic Net Solutions to Problem of Two Tilts—with Applications to Core Orientation. C. H. Johnson. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 663–685.—A simple solution is given of the problem of determining the original dip of beds below an angular unconformity. The equations obtained for this solution are then used to construct various nets and it is shown that they are the basis of Fisher's stereographic-net solution which was recently published. Difficulties which may arise when the lower beds are overturned, either before or after secondary tilting, are discussed and a new stereographic-net solution is given which indicates at a glance when overturn has occurred.

The application of these methods to the determination of dip by the magnetic orientation of cores is discussed. S. E. C.

1061. Additions to Oil Reserves in California during 1938. H. W. Hoots. *Bull. Amer. Ass. Petrol. Geol.*, June 1939, **23** (6), 932–948.—Developments in 1938 added an estimated 253 million brls. to the state's known oil reserves. Five new fields were discovered in 1938—Wasco field, East Coalinga Eocene field, Coles Levee field, Richfield Western field and Aliso Canyon field.

New producing zones were discovered in five fields. Prolific production was found in the Vedder zone in the Greeley field. The Del Amo (Miocene) zone has been developed at Torrance. Three new zones were discovered at the western end of the Monte-

bello field. Miocene production was obtained at North-west Long Beach, and a deep zone of doubtful economic value was found in the Signal Hill area of Long Beach.

Extensions were made to the Wilmington, Rosecrans, Torrance, Potrero, Ventura Avenue and West Cat Canyon fields. Two new gas-fields were found (Willows and Potrero Hills) and the Rio Vista gas-field was extended.

The East Coalinga Eocene field is probably a stratigraphic overlap with a known thickness of 587 ft. of unusually permeable medium coarse oil sand. The Wasco field, discovered by the deepest well in the world, is probably small.

The reflection seismograph continues to be an important, almost indispensable, tool in geological exploration in this state.

The present rate of discovery of additional reserves, although keeping pace with consumption, should be improved in order to augment the decreased reserve supply. The rapidity of drilling wells in new fields and the resulting excessive production or capacity to produce is now interfering with normal exploration and the attainment of a desirable rate of discovery. G. D. H.

1062. Foreign Oil Developments in 1938. B. B. Zavoico. *Bull. Amer. Ass. Petr. Geol.*, June 1939, **23** (6), 949–967.—There were no outstanding discoveries in the U.S.S.R. in 1938, although geological and geophysical work have revealed a number of major structural features which are ready for drilling. Some important developments took place on the Apsheron peninsula. The Maikop–Kuban district has a number of shallow, pinching-out, shoreline sand bodies. The Ural–Volga Permian basin is of considerable interest.

The Venezuelan production rose, with the western part giving 72·9% of the total. Eastern Venezuela made rapid strides during 1938 and commercial oil-fields were discovered at El Tigre and Jusepin.

In Iran the Gach Saran field has been further outlined, and at Agha Jiri promising results have been obtained. A deep gas-field has been discovered at Pazanum.

Nothing of importance happened in the Netherlands East Indies. The Roumanian production declined. Deep Meotic production was found in the Baicoi–Tintea field.

The Mexican production fell by 23%. In Iraq all the exportable oil was obtained from Kirkuk, whilst Naft Khana gave a little oil for local requirements.

All the Colombian production was from the Infantas and La Cira fields. The most important developments in Trinidad were associated with the Guapo fault zone. Drilling began in the North basin.

The Canadian production increased very markedly during 1938 due to developments of the Madison production at Turner Valley. The Egyptian production also rose during 1938. G. D. H.

1063. Development in Southern Arkansas and Northern Louisiana in 1938. W. C. Spooner. *Bull. Amer. Ass. Petr. Geol.*, June 1939, **23** (6), 896–902.—The development in Southern Arkansas and Southern Louisiana during 1938 was primarily in search of oil and gas from the Glen Rose formation and the Smackover limestone. New producing horizons have been found in the developed Caddo Cotton Valley and Shongaloo fields of Louisiana. At Caddo the Paluxy sand yields oil from thin lenticular sands.

The present knowledge of stratigraphy indicates that future production of oil and gas from this region will be obtained principally from the Cotton Valley formation and from the Smackover limestone. The former consists of shale and interbedded sand; the latter is made up of an upper porous and oolitic member—the oil- and gas-producing member—and a lower dense non-porous member. Both these formations have shown marked lithological changes which determine in large part their suitability as reservoirs for oil and gas accumulation.

A structure map and a list of the wells drilled outside the producing fields are given. G. D. H.

1064. Development in Rocky Mountain Region in 1938. J. M. Kirby and H. N. Hickey. *Bull. Amer. Ass. Petr. Geol.*, June 1939, **23** (6), 903–931.—There was only moderate activity in the Rocky Mountain Region during 1938. New fields were discovered at Cole Creek (Wyoming), Wilson Creek (Colorado), North Cut Bank (Montana), Big Hollow (Wyoming) and Shoshone (Wyoming). Extensions to old

oil-producing areas were made at Kevin–Sunburst (Montana), Hamilton dome (Wyoming), Lance Creek (Wyoming), Shoshone (Wyoming). Deepening or recompleting wells in proved fields gave gas and oil in the Wasatch at Hiawatha (Colorado), and oil in the Tensleep at Mahoney. Drilling in 1938 gave gas at Cut Bank 4 miles north of the main area; the Clay Basin (Utah) Dakota gas area was extended; gas was discovered at Beaver Creek (Wyoming) and Oil Springs (Wyoming). The Muskrat gas area was substantially extended.

Details of the numbers of wells drilled in the various areas are given, and the important dry holes are noted. Seven maps are included.

The gross production of oil in the Rocky Mountain region (exclusive of Southeastern New Mexico) for 1938 is estimated at 25,450,205 brls., as compared with 27,397,660 brls., in 1937. G. D. H.

1065. Development of the Turner Valley Gas- and Oil-Field. V. Taylor. *Petrol. Tech.*, August 1939, A.I.M.M.E., Tech. Pub. No. 1099, 1–16.—97% of Canada's oil output in 1938 was obtained from the Turner Valley gas- and oil-field. In 1913 light oil was found in upper Cretaceous beds; in 1922 naphtha was found in the Palæozoic limestone The first large crude oil producer was completed in 1936, proving crude oil on the west flank of the structure The structure is a highly faulted, closely folded anticline underlain by a major overthrust fault. The eastern flank may be due to drag folding To date the total productive length is almost 18 miles. The Palæozoic limestone has two principal producing horizons. The upper is almost a pure dolomite and 75–100 ft. thick; the lower is also dolomitic and 20–120 ft. thick. Three sands above the Palæozoic limestone give oil in small quantities, but production is sporadic.

The peak naphtha production was in 1930, after which the output fell in spite of increased gas production. All gas wells were then prorated to 40% of their open-flow capacity. In 1938 naphtha production at most wells had dropped almost to zero; separator production from cap wells averaged only 257 brls./day, and gasoline-plant recovery was 1150 brls./day.

The productive part of the structure has a closure of at least 4650 ft. with gas occupying 2500 ft. at the top. By the end of 1938 65 crude oil wells had been completed.

Although the early development was all done with cable tools, the rotary has now almost entirely displaced them. Drilling is difficult. At present the two common methods of drilling-in are by the circulation of a straight bentonite mud or a heavy crude oil.

The production methods in naphtha wells and crude oil wells are described. The present regulations give a 40-acre spacing of wells. All wells in the crude oil area are acidised at least once, and generally the treatment is beneficial. In 1937 crude oil proration was introduced.

The area of the gas cap has been accurately defined, but the oil boundary is known on one side only. The gas cap is estimated to have 340,000,000 to 540,000,000 million cu. ft. The oil productive acreage covers 3743 acres, but the probable area of the field is estimated at 15,275 acres and the possible oil reserves at 150,000,000 brls.

G. D. H.

1066. Major Areas Develop as Rice County Pools are Extended. D. Dalrymple. *Oil Gas J.*, 3.8.39, **38** (12), 32–33, 37.—This area has a potential of about 1,000,000 brls./day. The first production in West Kansas was obtained in 1923, and since 1926 development has gone on steadily. The five main areas are: Wherry pool, Silica pool, Chase district, Geneseo pool and the Bloomer–Habiger–Stumps area. Geneseo produces from the Arbuckle lime and lies on a range of buried hills. The Wherry pool yields oil from a conglomerate.

Relatively few wildcats have been drilled in East Rice County. Thousands of acres of proven land in Rice County remain to be developed, and many more are favourably located but not yet explored. Rice County lies on the south-east "nose" of the Central Kansas uplift. Most of its production is from Ordovician rocks. Oil and gas have been found in the Arbuckle lime, Lansing–Kansas City lime, conglomerate, Mississippi chat, Wilcox or Simpson sand and pre-Cambrian quartzite. G. D. H.

1067. Seeking New Fields in Many Sections of Alberta. J. L. Irwin. *Oil Gas J.*, 17.8.39, **38** (14), 30, 31, 115.—At Steveville 150 miles east of Turner Valley a heavy gas flow with some gasoline was found. Important drilling campaigns have been planned at Pouce Coupe and Wainwright. Encouraging oil and gas discoveries have been made at Lloydminster, and gas has been encountered on the Kootenay dome 40 miles west of Calgary. The Ram River and Clearwater wells have also found gas. Five wells are being drilled at Taber, 120 miles south-east of Turner Valley.

The extreme producing wells at Turner Valley are 17 miles apart, but the bulk of the Turner Valley crude is from an area in the south, 5 miles long and 1 mile wide. The Turner Valley prospects seem quite bright.

In May a new oil refinery was opened at Calgary, and a further refinery at East Calgary is expected to be ready before the end of the year. G. D. H.

1068. New Wells Stir Interest in Sandoval Field. H. F. Simons. *Oil Gas J.*, 24.8.39, **38** (15), 35.—A Devonian lime pool has been proved near Sandoval. This underlies a Benoist-pay horizon which was drilled in 1908. The Devonian wells range 2900–3000 ft., and are good producers. The initial average production is 1248 brls./day. To date the proven area is a little over a mile long. Dry wells have been drilled between producers, and the inconsistency shown by the differences at which the pay formation has been found have made many of the operators quite cautious. The structure of the Devonian beds appears to be unpredictable at present, but it is believed that the Devonian structure will be sharper than that above. G. D. H.

1069. Five-County Campaign along Historic Wabash. H. F. Simons. *Oil Gas J.*, 31.8.39, **38** (16), 19–20.—It is uncertain whether the production from Gibson and Posey counties, Indiana, and Wabash, White and Gallatin counties, Illinois, is from several local structures or from a major structure. Two good pay zones have been discovered along the Wabash river, and there are possibilities of a third and fourth.

The Griffin field was not developed rapidly due to the lack of a pipe-line outlet and to other factors. Good saturation was found in the Cypress sand at about 2500 ft. Oil has been found on both sides of the river. G. D. H.

1070. Two Mississippi Structures are given New Exploration. *Oil Gas J.*, 31.8.39, **38** (16), 85.—The Glass dome is 7¾ miles south-west of Vicksburg, and merits seismic investigation and deeper testing than it has hitherto received. At Blakely 7 miles north-east of Vicksburg seismic examination is also required. In addition to the Blakely structure there are noticeable undulations between Vicksburg and the Warren-Yazoo County line. The significance of the flexures is unknown, but they probably represent the eastward Bluff extension of a series of structural highs favourable for oil and gas accumulation beneath the thick alluvium of the Mississippi valley, or they may represent noses of a major structural high beneath the alluvium.

The Satartia structure of Yazoo County is faulted and shows signs of bitumen, but the source of such bitumen is unknown. Again geophysical examination is required, for extensive slumping has disturbed the surface geology. G. D. H.

1071. Wasson–Bennett Merging to make Largest most Active Field in Permian Basin Area. H. H. King. *Oil Wkly*, 7.8.39, **94** (9), 20–23, 26, 28.—The pending merger of the Wasson and Bennett fields into a single producing area will give the Permian basin its largest known stretch of productive acreage. Undrilled proved locations are adequate to ensure continuous drilling for a period of years.

The Wasson sector is conservatively credited with 34,000 acres and the Bennett field with 3,000. Between are at least 5,000 acres. Expansion of both fields is also probable. The output has been restricted and the ultimate recovery is expected to exceed 250,000,000 brls.

Some consider the area to be a dome with oil in the lime section, but the most popular interpretation is that of a broad anticline with north-west–south-east and north-east–south-west cross-folding. The oil- and gas-producing zones are classed as the Blaine lime or the upper middle section of what is sometimes called the San Andres. It occupies a lower section of the Permian than most lime fields in the district.

All the wells are drilled by rotary. A shale at about 1100 ft. is rather troublesome. The wells are generally subjected to multistage acid injections as well as shooting.
G. D. H.

1072. Results of Australian Drilling Discouraging. Anon. *Oil Wkly*, 21.8.39, **94** (11), 48, 50.—In the Gippsland area of Victoria scout bores have gone down to the Jurassic, showing a great thickness of Tertiary in the area, but no oil and gas was encountered or new structures located in the recent drilling. In the vicinity of Lakes Entrance three bores were completed and a little oil bailed. Operations are suspended pending consideration of a repressuring scheme.

Inconclusive tests have been drilled and small shows of oil reported in the Permo-Carboniferous Desert Basin. There are well-defined domal structures in the Tertiary of the North-west Basin where there are also Palæozoic and Mesozoic rocks.

The logs of the wells drilled in Victoria are given in tabular form. G. D. H.

Geophysics.

1073. The Relationship of Geophysics to Geology. F. M. Kannenstine. *Geophys.*, 1939, **4** (3), 149–154.—Geophysical prospecting was developed when the need arose for better methods of finding structural anomalies. Doubt is now being expressed as to the future success of these methods in their present form and the value of structure is being decried in favour of stratigraphic traps. It is pointed out, however, that there are probably few stratigraphic traps not associated in some way with structure and, in addition, it is probable that the most important accumulations will continue to be of a structural type. Areas in the U.S.A. where more detailed structural information is required are listed. The relative values of the various geophysical methods for this work are examined briefly and it is concluded that the reflection seismograph will remain supreme at least for the next few years. S. E. C.

1074. On the Strategy and Tactics of Exploration for Petroleum, III. E. E. Rosaire. *Geophys.*, 1939, **4** (3), 155–166.—The application of the principles of war to exploration for petroleum is discussed in this series of articles, the principles considered in the present paper being those relating to the objective and to economy of force.

The principle of the objective in exploration is the discovery of oil under the most favourable conditions of time, place, and investment.

The principle of economy of force refers largely to the choice and sequence of tactics. These were referred to in an earlier paper and it was concluded that prospects should first be located by the cheapest appropriate method and evaluated by the successive use of appropriate methods of higher cost. The development of prospects in a particular area should not be initiated by any given method until the area has been primarily explored by the cheapest appropriate method. In the present paper the "appropriateness" of the methods is considered.

Exploration methods are divided into two major groups, structural prospecting methods and stratigraphic prospecting methods. Structural prospecting methods are further subdivided into two classes, pseudo and true, the former including profiles determined by refraction shooting, electrical, gravity, and magnetic methods. There is little justification for the general use of pseudo-structural methods on account of their limited depths of penetration and high observational errors. True structural prospecting methods are those using the reflection seismograph and the drill. The main limitations to these methods are practical rather than theoretical and often they may be charged simply to misuse. The reflection seismograph suffers, however, from the limitation that if production is not closely associated with the structure, accurate depth determinations are not sufficient.

There are five types of stratigraphic prospecting methods: magnetic, electrical, accoustical, gravitational, and chemical. The general field of usefulness for these methods is in reconnaissance; the fundamental limitations are the absence of any indications as to the depth or relief of the structure indicated.

The estimation of discovery costs is discussed and it is shown that on this basis also stratigraphic prospecting methods are better suited for reconnaissance work and that

an exploration programme should be initiated by them. Any prospects then discovered should be evaluated by the structure prospecting methods. S. E. C.

1075. A Problem in Seismic Depth Calculation. R. F. Beers. *Geophys.*, 1939, **4** (3), 167–175.—The calculation of the depth to a reflecting surface is subject to error when reflection surveys are carried out in area of great topographical relief. The customary method of depth determination yields a result in which the structure bears the impress of the topography. A method of depth calculation which seems to overcome these difficulties has therefore been developed. The velocity function of the entire geological section is measured if possible, otherwise it is estimated. It is then distributed with respect to the portion of the section embraced in the reflection path at each station. The use of this method is simplified by preparing velocity-depth curves and time-depth curves for varying degrees of erosion. The method may also be employed to advantage in cases where there is a thick cover of sediments with an abnormal velocity, the path then being divided into two portions. S. E. C.

1076. Determination of Density for Reduction of Gravimeter Observations. L. L. Nettleton. *Geophys.*, 1939, **4** (3), 176–183.—The density of the surface material is frequently obtained by measurements on small samples and the result used in the Bouguer correction for elevation of a station. This method is apt to introduce considerable errors into the correcton and it is suggested that a more accurate measurement of density can be made with the gravimeter itself. Briefly, the method consists in making a special gravimeter traverse across a topographical feature. A series of gravity values is then calculated for each station, using the usual reductions for latitude and free air corrections but making the Bouguer correction for a number of different densities. In this manner a series of profiles can be drawn for the selected densities and the value of density used in the profile which approaches closest to a straight line across the topographical feature is the density of the surface material. S. E. C.

1077. Terrain Corrections for Gravimeter Stations. S. Hammer. *Geophys.*, 1939, **4** (3), 184–194.—The topographic correction is divided into two parts, the Bouguer correction and the terrain correction. In order to determine the latter an adequate topographical map is necessary. A transparent terrain correction zone chart, of which an example is given, is placed on the map and the difference between the elevation of the station and the average elevation under each zone of the chart is determined. The terrain correction is then calculated for each zone by means of special tables published in this paper, and finally these corrections are then summed to give the total correction for the station. The tables are based on the formula for the gravitational attraction of a vertical hollow cylinder at a point on the axis and in the plane at one end of the cylinder. The density of the surface material has been assumed to be 2·0. For any other value of density the figures given must be multiplied by the appropriate factor. S. E. C.

1078. On Geochemical Prospecting. I. L. Horvitz. *Geophys.*, 1939, **4** (3), 210–228.—Geochemical prospecting methods may be divided into three types. The first is the search for visible oil and gas seeps, the second is the analysis of interstitial soil air, and the third is soil analysis. It is found that soil analysis, in contrast to the analysis of interstitial soil air, yields satisfactory results with small samples and even with completely water-logged samples. Briefly, the method consists of freeing the entrained hydrocarbons from the sample of soil, removing from them substances such as carbon dioxide and ammonia, and finally determining their constituents by fractional condensation methods. These may include methane, ethane, propane, butane, and a group of heavier substances referred to as pseudo-hexane. Methane is usually of importance only in arid regions, ethane and propane are the most valuable indications, and the pseudo-hexane is useful in areas where it is impossible to obtain hand auger samples from depths of more than 2–4 ft. The results of many surveys show that the greatest concentrations of these hydrocarbons are around the edges of established production, thus producing what is known as a halo pattern. Some typical examples illustrating these points are given.

A further development of the soil analysis method is the search for oxidized and polymerized hydrocarbons in the soil. It is found that these are present in far greater proportions than the lighter hydrocarbons, thus simplifying the analytical procedure. The results obtained from the determination of these heavier hydrocarbons agree very well with those obtained from the lighter. S. E. C.

1079. A New Recording System for the Magnetometer. A. Graf. *Beitr. angew. Geophys.*, 1939, **7** (4), 357–365.—A photo-electric recording system for the magnetometer is described. This has the following advantages over the normal method of photographic recording. Readings may be obtained at any moment without waiting for a full plate to be exposed. Readings may be obtained at places distant from the instrument and there is no need to approach or disturb the instrument in order to fit new plates. Paper speed is variable. The sensitivity can be increased by the use of Merz's D.C. amplifier and multiple recording is possible. S. E. C.

1080. Comparison of the Theoretical and Practical Determinations of a Gravity Anomaly. S. v. Thyssen and F. Lubiger. *Beitr. angew. Geophys.*, 1939, **7** (4), 366–391.—In order to examine the difference between a calculated and a measured gravity anomaly the gravity effect of a small valley was utilized. The measurements were made with a Thyssen gravimeter set on a stone bridge crossing the valley. The calculation of the anomaly was carried out by three methods, the first involving the use of Helmert's formulæ, the second being Jung's two dimensional solution, and the third making use of Schleussner's reduction tables. The calculations are described in detail. It is shown that these three methods give satisfactory results which are in accordance with the gravimeter measurements. S. E. C.

1081. Gravity Anomalies Between the Aller and Steinhuder-meer Lines. R. v. Zwerger. *Oel u. Kohle*, 1938, **14** (46), 943–953.—As a result of the intensive geophysical work carried out in the last few years a number of important gravity anomalies have been discovered. Each of these is described in detail. This discovery of new lines of uplift completes the tectonic picture of the area; on the one hand they form the continuation of the hercynian axes of the subhercynian basin; on the other hand they complete the picture of the Rhenish tectonics by the discovery of a probable flat salt anticline at the west margin of the zone with predominant Rhenish strike. From the point of view of petroleum, the value of these structures is variable. Either the strata from the Lower, and perhaps the Upper, Cretaceous to the Emscher are folded so that the Lower Cretaceous reservoir rocks have an anticlinal structure, or the folding had already taken place in the Kimmeridge and the Wealden–Valendis is transgressive. Even in the latter case oil accumulation of a secondary nature is possible in the Lower Cretaceous. S. E. C.

1082. Seismic Work in the Region Between the Aller Estuary and the Weserbergland. P. Rossle. *Oel u. Kohle*, 1938, **14** (46), 954–956.—The surveys in this region were carried out by the refraction method, using fan and lineal shooting. A description is given of the results obtained, particularly of velocities in the various areas and strata. S. E. C.

1083. The Influence of the Accuracy of Scale Readings on the Usefulness of Gravimeter Measurements. A. Schleussner. *Oel u. Kohle*, 1938, **14** (46), 957–959.—The conclusions drawn from a discussion of this subject are that in the case of local surveys, a small, constant error in the scale value is of no consequence in the interpretation of gravimeter measurements. Also, in the case of regional measurements, the influence of a somewhat uncertain scale value is without great significance. S. E. C.

1084. A New Apparatus for the Rapid Estimation of the Velocity of Elastic Waves in Cores. S. v. Thyssen. *Oel u. Kohle*, 1938, **14** (46), 960–962.—An apparatus has been designed by means of which the velocity of longitudinal waves in cores of any rock can be determined in a few minutes. A piece of unprepared core is put on one of

the plates of a condenser. The ends of the core may be made flat by cutting or by a thin coating of plaster. The condenser plate is then made to vibrate at various frequencies until the natural frequency of the core is reached. At this point there will be maximum resonance in the core and this is determined by a sensitive piezo-electric indicator. The velocity of longitudinal waves in the core is then calculated from the natural frequency. S. E. C.

1085. An Investigation of the Seismic-Electric Effect. K. H. Waters and W. Wen-Po. *Beitr. angew. Geophys.*, 1939, **7** (4), 337–346.—Experiments were made in order to discover whether the seismic-electric effect is due to changes in the resistivity of the ground. A four-electrode system was used, the current electrodes being 350–400 ft. apart and on a line passing through the shot point, and the potential electrodes on a line at right angles to this and passing through the current electrode nearest the shot point. The results obtained indicate that the effect is due to a change in resistivity of the bulk of the ground as the compression wave passes through it. The theoretical discussion is simplified by considering only the effect of a sudden discontinuity of resistivity approaching the current electrode from the shot point, the plane of the discontinuity being parallel to the line of the electrodes. This problem is solved by the Method of Images. It is shown that even with a very sharp change of resistivity the initial potential is smooth and of little use to give the exact time of the wave and further, that the potential variation is much more complicated than the corresponding ground motion. Another disadvantage of the method is that it is considerably affected by wet and thundery weather conditions. S. E. C

1086. On the Watson Method for the Evaluation of Geo-Electric Resistance Measurements. F. Gassmann. *Beitr. angew. Geophys.*, 1939, **7** (4), 347–349.—Watson's formulæ for apparent specific resistance are corrected and a method given for the simplification of numerical calculations. S. E. C.

1087. The Static (Barometric) Gravimeter for Measurements on Land and Sea. Part II. H. Haalck. *Beitr. angew. Geophys.*, 1939, **7** (4), 392–417.—Part II of this series deals with the sources of errors and the influence of those errors on the measurements. After a short discussion on the theory of the source of error, individual errors are dealt with in detail. These include the effect of temperature variations, pressure variations, volume variations, variations in scale value, and the effect of frictional and capillary forces. The most important and difficult technical problem in the development of the static gravimeter was the considerable effect of temperature variations on the scale position. A detailed description is given of the means used to overcome this trouble. S. E. C.

1088. The Static (Barometric) Gravimeter for Measurements on Land and Sea. Part III. H. Haalck. *Beitr. angew. Geophys.*, 1939, **7** (4), 418–448.—Part III of this series deals with the use of the instrument on board ship. The special conditions arising in such circumstances are discussed and the alterations necessary in the standard model are described. The effect of the irregular vibrations of the ship on the scale position is examined critically and finally the results of four series of measurements made between Bremen and Hamburg are discussed in full. S. E. C.

Production.

1089. A Résumé of the Application of Gravel Packing to Oil Wells in California. W. A. Clark. *Petrol. Tech.*, August 1939, A.I.M.M.E., Tech. Pub. No. 1079, 1–8.—Gravel packing is used to prevent sand movement with the consequent troubles of caving and wear of well fittings. The methods of gravel packing are briefly described. The extra cost due to such an operation rarely exceeds 10% of the cost of drilling the well. Zones 25 to 666 ft. in thickness have been packed at depths ranging 1100 to 6700 ft.

The cumulative production from gravel-packed wells is, as a general rule, greater than that from conventional types over the same production period. This is explained by deferred or lost production in the latter wells due to time spent in pulling and bailing. It appears that less sand is produced with the oil in gravel-packed wells than in ordinary wells. Pump repair costs were lower in the gravel-packed wells. It is desirable that the gravel size should be carefully chosen with respect to the oil sand grain size.

G. D. H.

1090. Visual Studies of the Flow of Air–Water Mixtures in a Vertical Pipe. S. Cromer and R. L. Huntingdon. *Petrol. Tech.*, August 1939, A.I.M.M.E., Tech. Pub. No. 1080, 1–10.—The flow of gas–liquid mixtures in vertical pipes occurs when oil and gas are produced from a well; when water is removed from gas wells with siphon lines and when liquids are elevated by means of air or gas lift. The column used was 2 in. diam., 98 ft. long and with 2 ft. Pyrex observation sections at 14-ft. intervals. At the base was a mixing chamber with no perforated nipple or foot-piece.

If the air enters the bottom of a flow column at an extremely low rate, it will merely rise to the surface of the liquid in small bubbles. At rather higher air rates the air forms bullet-shaped slugs at the bottom, which acquire a trail of small, round air bubbles higher and gives almost a froth between the slugs still higher. At the point of maximum efficiency (37 cu. ft. air/brl.) pistons of air and water were seen 16 ft. up the column, but higher the short pistons merged to form longer ones. The air piston was at all times surrounded by an annulus of water flowing downwards. The water velocity apparently increased upwards. Maximum water flow was attained with an air–water ratio of 60·3 cu. ft./brl. Here the formation of pistons was observed higher in the column, and there was no downflow of water around the air pistons.

At still higher air rates the pistons gradually disappeared and water appeared to be travelling both as droplets suspended in the air stream and in an annular ring along the tube walls. A further increase caused the air core to carry less and less water until it became comparatively free of it, and water rippled upwards along the sides of the flow tube in the annular ring. On sufficiently increasing the air rate, the friction load produced by the air flowing through the pipe became greater than the hydrostatic head of water. This obviously prevented water from entering the pipe and a second condition of no liquid flow was reached.

G. D. H.

1091. The Economics of Overdevelopment. J. D. Gill. *Petrol. Tech.*, August 1939, A.I.M.M.E., Tech. Pub. No. 1084, 1–8.—Various aspects of the economics of overproduction are considered in some detail, and the arguments put forward demonstrate the complexity of the problem. It is a debatable point whether the alleged waste of money and energy in overdevelopment is more serious than the idleness of the associated and supplementary workers who might have been unemployed but for overdevelopment.

In the confusion over the nature of the ultimate control of economic endeavour, many have embraced the philosophy of control based on engineering abstractions and experiments. But this has a danger that arbitrary technology will be placed in control, because practicability requires the adoption of the tenets of one of several schools.

The Secretary of Agriculture does not seem to have learned to substitute technological control for economic control, although he has had the resources of the Federal Government and taxation to support him in an effort to make the experiment succeed. In the end the efforts to replace economics by technology only invite experiments in arbitrary control where the conservation argument is absent, and some professional economists and others have begun to think that there is no useful competition in business, and that thoroughgoing governmental regulation of business is necessary.

G. D. H.

1092. Multistage Stabilization of Crude. H. S. Gibson. *Petrol. Tech.*, August 1939, A.I.M.M.E., Tech. Pub. No. 1085, 1–12.—Multistage stabilization as practised at Haft Kel is a process for preventing the greater part of the casing-head gasoline hydrocarbons from ever leaving the crude, instead of allowing them to be vaporized and then recovered from the lighter gases by the usual compression or absorption processes. The operating conditions and results at Haft Kel are described, and the

operating pressures, the efficiency, and the production system at Haft Kel are discussed. Six stages are used.

When casing-head gasoline is recovered as a separate liquid in the Iranian fields, it is blended with the crude, for the only outlet is through the refinery, and the crude oil pipe-line offers the cheapest means of transportation. It is under these conditions that the retention of the butanes and pentanes in the crude by multistage stabilization is a most attractive process, possessing as it does, the following advantages: (1) extreme simplicity, (2) low first cost, (3) easy installation, (4) practically 100% operating time efficiency, (5) no operators required, (6) no water or other services required, (7) negligible maintenance, (8) once established very little routine testing is necessary.

For reasonably efficient multistage stabilization it is essential that the flowing pressures of the wells should be relatively high, *i.e.* they should not, in general, be less than about one-third of the saturation pressure of the crude in the reservoir.

The efficiencies compare most favourably with those obtainable by the best design of absorption plant. G. D. H.

1093. Principles of Well Spacing. M. Muskat. *Petrol. Tech.*, August 1939, A.I.M.M.E., Tech. Pub. No. 1086, 1–15.—The problem of ultimate recovery and well spacing has been investigated mathematically on the basis of experiments with a uniform sand column. It is concluded that from a strictly physical point of view there is no basis for believing that the absolute ultimate recovery of oil that can be produced from a uniform and non-lenticular sand through the agency of dissolved gases will materially depend upon the number of wells used to drain the reservoir. There is, however, a definite variation of the economic ultimate recoveries that can be derived from a given reservoir with the number of wells, if we consider the economic ultimate recovery to refer to that which can be obtained with the individual well-production rates exceeding a pre-assigned minimum. For the linear system, which was treated in detail, it was found that this economic ultimate recovery will increase as the number of wells used increases. When the minimum limiting production rate is small or the sand columns are highly permeable, the economic ultimate recovery rises rapidly as the number of wells is first increased, but quickly attains values which are thereafter no longer appreciably increased by further drilling. For tight sand columns, or if the lowest production rate at which the operation of a well would still be profitable is high, one must make the well spacing fairly small in order to approach ultimate recoveries which would be obtainable in highly permeable sands or with low minimal production rates.

Although but little practical significance can be attached to the numerical results derived, because of the various assumptions underlying details of the analysis, their broad features show a close correlation with general opinion regarding the well-spacing problem that has been previously expressed in the literature. G. D. H.

1094. Specific Problems in the Chemistry of Acidising Wells. C. E. Clason. *Petrol. Engr*, August 1939, **10** (12), 72.—Corrosion of oil-well equipment by acids used to increase production in limestone formations has been limited by (*a*) the use of inhibitors and (*b*) electrochemical methods. An extremely low viscosity acid of high penetrating value has also been developed. Water has been found the best medium for forcing the acid into the formation, as it increases the speed of placing the acid, washes the formation and dilutes the heavy spent acid salts, allowing their easier removal. Treatment is also improved by adding the penetrative medium to the washing water. In the Panhandle and parts of West Texas the dolomites contain gypsum which is first dissolved by the acid and then precipitated, resulting in plugging of the formations. Similarly magnesium carbonate is reacted on much less slowly than calcium carbonate and is liable to be loosened from the formations resulting in further plugging. Delayed action acids are accordingly used to equalize the action on the two types of carbonates and also in fast acting limestones in order to extend the action. In the latter cases penetrating acid is used first until the pressure drops, followed by the delayed action acid. Some forms of silica tend to form a gelatinous mass under the action of acid, while further pore clogging may be caused by fine needle-like crystals of acid soluble silicates mixed with colloidal silicates in the spent acids. Similarly acid treatment of very fine-grained rocks may be more harmful than beneficial. Delayed action can also be obtained by increasing the pressure. Emulsion

breaking also creates difficulties, the particular chemical chosen being best placed in the formation with the acid. Adequate examination should be made of core cuttings and full records kept of oil production before and after acidisation. C. L. G.

Crude Oil.

1095. Atlanta, Arkansas, Crude Oil. Anon. *Petrol. Engr*, August 1939, **10** (12), 75.—A Bureau of Mines analysis has been made of a sample of crude oil from the discovery well of the Atlanta district in Columbia Country, Arkansas. The crude oil is of paraffin base and has a specific gravity of 0·813, a sulphur content of 0·49%, a carbon residue content of 0·4% and viscosity S.U. at 77° F. of 38 secs. On Hempel distillation the crude oil yielded 34·9% of total gasoline and naphtha (8·6% of light gasoline), 19·5% of kerosine distillate, 13·2% of gas-oil, 12·8% of non-viscous lub. dist., 4·5% of medium lub. dist. and 14·6% of residuum. C. L. G.

Gas.

1096. Dehydration of Natural Gas by Silica Gel. H. de Raay. *Petrol. Engr*, August 1939, **10** (12), 45.—A description is given of a silica gel plant for the dehydration of natural gas in Mene Grande field Venezuela, removing 586·55 lb. per day of water from 8,827,500 cu. ft. of natural gas. The plant is installed between the outlet of the compression plant and the intake of the refrigeration or expansion plant, and consists of three absorbers and one heater. One absorber is used to absorb the water, while one is being dried by heated dry gas and the third cooled by cold dry gas. The absorbers consist of steel high-pressure cylinders containing two grates, one near the bottom and one half-way up the cylinder The upper section contains successive layers of fine gravel, No. 1 quality (high sensitivity) silica gel, fine gravel, No. 2 quality silica gel and fine gravel, while the lower section contains the same layers in reverse order. The gas heater is a standard tubular heater in which cold dry gas is heated by live steam. High-pressure gas is passed from the top to the bottom of the absorber, and from thence to the refrigerating plant, until the silica gel is saturated with water. The second absorber is then used and so on. The cold dry gas is heated in the gas heater to about 165° C. and passed up into the saturated absorber. Another portion of cold dry gas is taken from the output of the refrigerating plant to cool the silica gel after the heating period. About 0·06 gal. per million cu. ft. of gasoline is lost by absorption in the silica gel, but may be recovered if the high pressure gas is returned to the wells for gas lift. The cost of the silica gel used in dehydration is given as $0·34 per million cu. ft., the silica gel lasting three years. C. L. G.

1097. Patents on Gas. Metallgesellschaft A.-G. and W. Herbert. E.P. 507,366, 14.6.39. Appl. 25.4.38. Synthetic production of motor spirit by catalytic conversion of CO and H_2.

G. W. Johnson. E.P. 507,567, 3.6.39. Appl. 13.12.37. Manufacture of gaseous olefines, in particular of ethylene, from products obtained in the catalytic reaction of CO and H_2, by leading the products at elevated temperatures in the presence of H_2 over a hydrogenating catalyst, and then cracking and/or dehydrogenating the resulting hydrocarbons in vessels constructed of coatings of silicon, titanium or chromium steels. W. S. E. C.

Polymerization.

1098. Midget Poly Plant Uses Combined Feed. J. P. O'Donnell. *Oil Gas J.*, 24.8.39, **38** (15) 59.—A U.O.P. midget polymerization plant is in operation at a Farmer's Valley (Penn.) refinery, running on a mixture of 263·5 million cu. ft./day (in terms of vapour phase) of liquid charge–condensed overhead from the Dubbs stabilizer–, 143 million cu. ft. of gas charge–uncondensed stabilizer gas–, and 132 million cu. ft. of spent recycle gas. The installation of this plant and some changes made in the

Dubbs cracking unit have increased the gasoline yield by 9·2% and the O.N. by 0·4, when operating on gas oil and by 7·3% and 0·8 resp. when operating on naphtha. Maximum retention of olefines is obtained by deep stabilization (to 4·5/5 lb.) and by cooling the stream to the distillate receiver to 57° F. and increasing its operating pressure to 60/80 lb. The combined charge contains 23·5% olefines, being 90/95% of the processable olefines available. The yield of 10 lb. polymer gasoline per lb. of catalyst is at present 36·97 galls., but is expected to reach 70 galls. The polymer gasoline has the following properties: Gravity 67·7°; Reid V.P. 34 lb.; I.B.P. 83° F., 32% to 212° F.; E.P. 430° F. C. L. G.

1099. Patent on Polymerization. Standard Oil Development Co. E.P. 507,439, 14.6.39. Appl. 14.12.37. Manufacture of dimers and trimers of olefines by polymerization with sulphuric acid. W. S. E. C.

Refining.

1100. Vapour Recovery and Stabilization. D. Smith. *Oil Gas J.*, 24.8.39, **38** (15), 53.—A description is given of the vapour recovery and stabilization equipment at two identical refineries in Europe, built for the production of high-grade gasoline from low-grade crude oil and operated for maximum recovery of products. The operations at the refinery included hydrogenation, cracking, distillation, chemical treatment and gas processing, the gas charge to the vapour recovery unit consisting of (*a*) gases from cracking units, (*b*) gases from primary distillation unit prestabilizer, (*c*) gases from let-down drums at hydrogenation units and (*d*) recycled gases from within the gas plant itself. C. L. G.

Analysis and Testing.

1101. Some Practical Aspects of Fuel Oil Testing. B. O'Connor. *Oil Gas J.*, 7.9.39, **38** (17), 52.—A discussion is presented of the manipulative technique and practical importance of various fuel-oil testing methods. The following items are covered: sampling; Pensky–Martens flash-point; Saybolt viscosity; Conradson carbon residue; sulphur content (bomb method); water and sediment; ash content; sediment, and copper strip corrosion test at 212° F. C. L. G.

Motor Fuels.

1102. Patents on Motor Spirit. Standard Oil Development Co. E.P. 507,246, 13.6.39. Appl. 1.1.38. Improvement of anti-knock value of motor fuels by adding a di-tertiary butyl ether of ethylene glycol and a metallo-organic anti-knock agent.

F. Uhde and T. W. Pfirfmann. E.P. 505,953, 19.5.39. Appl. 29.8.38. Manufacture of high-quality benzine and diesel fuel by hydrogenation of tars prepared by carbonization, consisting in separating the tars by mixing with middle oils obtained by the reduction of CO and H_2, into two components of different specific gravity. A lighter fraction together with a part of the middle oils, is hydrogenated in the gas phase and a heavier fraction is hydrogenated in the liquid phase.

W. T. Hancock. U.S.P. 2,162,715, 20.6.39. Appl. 1.9.37. And U.S.P. 2,162,717, 20.6.39. Appl. 1.11.38. Refining of cracked distillates containing gasoline by first polymerizing the vapours at 200–500° F. but below cracking temperature by passing them through an adsorptive material. The gasoline is then mixed with an independent heavier oil under pressure to keep the gasoline liquid; the pressure is then reduced and the gasoline fractions vaporized.

W. T. Hancock. U.S.P. 2,162,716, 20.6.39. Appl. 19.10.38. Refining of petroleum hydrocarbons by heating them to cracking temperature to form unvaporized residues and vaporized lighter hydrocarbons containing a cracked gasoline fraction.

The vaporized fractions are then separated from the residue and the gasoline polymerized and the vapours passed through an adsorptive substance. The gasoline is then mixed with the residue under pressure, the pressure is then reduced and the gasoline fraction vaporized.

D. S. McKittrick. U.S.P. 2,162,963, 20.6.39. Appl. 28.8.37. Process for desulphurizing hydrocarbon distillates by extraction with a solvent, *e.g.* liquid SO_2, aniline, etc.

W. C. Ault and C. A. Hochwalt. U.S.P. 2,162,992, 20.6.39. Appl. 3.3.36. Refining of cracked distillates to remove gum-forming substances, by contacting the vapour substantially free from steam, at 175–185° C. with a liquid catalyst, *e.g.* an acid of phosphorus.

M. P. Youker. U.S.P. 2,163,113, 20.6.39. Appl. 14.10.35. Conversion of hydrocarbon gases into gasoline and synthetic crude, by treating at elevated pressures and at 900–1200° F. a mixture of butane and a kerosine distillate having a carbon residue of less than 1%; 20 parts of butane by weight are admixed with 1 part of kerosine distillate.

J. R. Rose. U.S.P. 2,163,155, 20.6.39. Appl. 22.11.37. Conversion of refinery gases into motor fuel by first liquefying the gases under 500–1500 lb./sq. in. pressure and heating the resultant liquid while still under pressure to cracking temperatures (500–1500° F.). The vapours are then contacted with a polymerizing catalyst and the product cooled to 50–75° F. The uncondensed gases are vented from the system, and the pressure on the resultant liquid reduced to separate from the liquid polymer gases for recycling.

J. A. Chenicek. U.S.P. 2,163,269, 20.6.39. Appl. 28.6.37. Method of separating high anti-knock constituents of cracked gasoline from those of relative low anti-knock value by subjecting the gasoline to the solvent action of cinnamaldehyde below 25° C.

W. A. Schulze. U.S.P. 2,163,312, 20.6.39. Appl. 11.5.37. Sweetening of sour hydrocarbon oils by treatment with a solid adsorbent catalyst impregnated with a solution containing cupric and chloride ions. The reaction is carried out in the absence of air. W. S. E. C.

See also Abstract No. 1115.

Lubricants.

1103. Patents on Lubricating Oil. Edeleanu Gesellschaft. m.b.H. E.P. 505,740, 16.5.39. Appl. 29.8.38. Solvent extraction of crude oil, residual oil, or lubricating oil using a selective solvent, *e.g.* pyridine containing 2–2·5% by volume of water. The mineral oil solution is cooled in the presence of a non-selective solvent (*e.g.* benzene, which solidifies at the temperature of treatment and/or in the presence of wax which is contained in the original oil or has been added), to temperatures at which the lubricating oil is precipitated together with the wax and/or non-selective solvent which crystallizes out. W. S. E. C.

Asphalt and Bitumen.

1104. Soil Stabilization using Asphalt Cut-Backs as Binders. J. C. Roediger and E. W. Klinger. *Assoc. Asph. Paving Techn. Proc.*, 1939, 1–36.—The authors stress the need for suitable terminology to distinguish between the various procedures and materials employed under the general term "soil stabilization" and put forward a suggested classification. The paper then describes the procedure employed in determining suitable proportions of water and cut-back for treatment of a particular soil and gives details of construction of a soil–asphalt pavement by the road-mix method. In determining the proportions of water and cut-back, portions of direct soil are mixed in a Kitchen–Aid mixer with definite amounts of water and cut-back to

determine the amount of water necessary to obtain satisfactory distribution of the cut-back. Further mixtures are then made with amounts of water above and below this moisture content and with amounts of cut-back from nil to the amount required to cause exudation of liquid under the compacting load in the Hubbard mold. 100 grms. of each of the mixtures are placed in 2-in. molds, tamped 50 times with a No. 1 tamper and 15 times with a No. 2 tamper and subjected to 10,000 lb. pressure for 2 minutes, the specimens should then be 0·9–1·0 in. high. Four specimens are made with each mixture, two being dried to constant weight at 140° F. and one dried and one undried specimen then exposed to a water absorption test for 7 days. The stability is finally determined on each specimen by the approved Hubbard–Field procedure with the exception that the test is made at room temperature without the water-bath. The water absorption test is made by placing the specimens in flat-bottom trays containing $\frac{1}{4}$ in. of water, the trays being either tightly covered or stored in a humidity cabinet at room temperature. At intervals up to 7 days the weight of the specimen is determined after removal of surface moisture with filter paper, the increase in weight being expressed as gm. of water absorbed per 100 sq. cm. of surface exposed to water. Volumetric swell is calculated from measurements before and after the absorption test.

It is considered that these tests should indicate the proportions of cut-back and water which can be easily mixed to give a mixture showing the maximum strength after exposure to water, minimum loss in strength due to exposure, low water absorption and minimum swelling. Results obtained with typical soils and a correlation of field and laboratory results are given. Photographs showing the various stages in construction of a pavement by the road-mix method are also given.

A. O.

1105. Stabilization of Soils with Emulsified Asphalt. R. R. Thurston and B. Weetman. *Assoc. Asph. Paving Techn. Proc.*, 1939, 37–85.—This paper discusses the factors involved in the stabilization of soil by means of emulsified asphaltic bitumen, with particular reference to the U.S. Bureau of Air Commerce specifications for emulsion for stabilizing airport runways. The latter specifications include limits for viscosity, miscibility with water, specific gravity, residue on heating, settlement, sieve test, demulsibility, dehydration, and properties of original bitumen. The Bureau of Air Commerce also requires stability tests to be made on soil–emulsion mixtures, these tests necessitate the use of expensive equipment and take a fortnight to complete and the authors give details of a simple compression machine and method of test which requires only a few days. Examination of soils of varying plasticity index indicated no definite relationship between the latter or material passing 200-mesh and strength of mixtures containing 4% of bitumen; further tests showed that compression strength is independent of soil constants but is related to percentage of clay and colloids present. The demulsibility, stone coating and cement mixing tests are considered unsatisfactory for determining the suitability of emulsion for use with a given soil and a stability test is described in which the soil to be stabilized is used. No correlation was shown between dehydration value and compression strength or rate of drying of emulsion–soil mixtures. The authors state that efficient stabilization with emulsion depends on the incorporation of sufficient minute particles of bitumen to fill the interstices of the soil, but experiments indicated that emulsions containing extremely small particles are not essential. Compression strength was found to increase with increased consistency of the bitumen used, but it is thought that excessively hard bitumen may be unsatisfactory. The quantity of bitumen should be sufficient to reduce water absorption in service without reducing compression strength owing to excess bitumen.

A. O.

Special Products.

1106. Waxes from Fatty Acids. German Conversion Process. Anon. *Chem. Tr. J.*, 18.8.39, 105, 140.—A process for the production of materials similar to wax or petroleum jelly by heating of distillation residues of fatty acids in the presence of catalysts which favour the splitting off of CO_2, and then reducing the resulting

products with hydrogen, is described by the I.G. Farbenindustrie A.-G. in E.P. 506,678 of 1938. As basic materials may be used the residues from the distillation of saponification products of natural oils or from the oxidation of paraffin hydrocarbons. The carboxylic acids condense to form ketones and are then filtered or settled to remove the catalyst and finally reduced, the carbonyl or carboxyl groups being converted into hydroxyl and/or methylene or methyl groups. Hydrogenation is preferably carried out between 200° C. and 400° C. at pressures of 160 to 200 atmospheres.

The products obtained are pale, frequently colourless, consisting mainly of high molecular weight alcohols and/or hydrocarbons and are suitable as salves or agents for the protection of metal, etc., from the action of gases. They have a considerably higher melting point and a viscosity constant within a larger temperature range than natural petroleum jelly. A product obtained by the oxidation of Fischer–Tropsch paraffin wax, following by distillation, catalytic heat treatment and hydrogenation had a similar appearance to petroleum jelly, smearing well and exerting no irritant effect on the skin. Its properties were acid value 0, saponification value 0, melting point 61° C. C. L. G.

1107. Patents on Special Products. N. V. de Bataafsche Petroleum Mij. E.P. 505,732, 16.5.39. Appl. 13.7.38. Manufacture of phenols and/or thiophenols from mixtures of these substances present in washing liquors originating from the refining of pressure distillates, by extraction treatment of the mixtures containing alkali in a quantity equivalent to the quantity of thiophenols present.

Standard Oil Development Co. E.P. 505,736, 16.5.39. Appl. 4.8.38. Production of olefine polymers of high mol. wt., by polymerizing olefines below — 10° C. in the presence of a solid metal halide of the Friedel-Craft's type dissolved in CS_2.

G. W. Johnson and I.G. Farbenindustrie A.-G. E.P. 506,038, 18.5.39. Appl. 18.11.37. Manufacture of butadiene by leading tetrahydrofurane in the gaseous phase at 250—450° C. using steam as a diluent, over phosphoric acid catalyst having a weak acid reaction inder the reaction conditions.

F. W. Johnson. E.P. 506,832, 6.6.39. Appl. 8.12.37. Manufacture of ethylene from saturated hydrocarbons.

W. A. Farenholtz, G. Hubbe and K. Blass. E.P. 507,521, 16.6.39. Appl. 4.5.38. Production of fatty acids by catalytic oxidation at temperatures below 120° C., of paraffin hydrocarbons which are liquid under conditions of treatment. The catalysts used are salts of metals of groups 6, 7, or 8 of the periodic system.

I.G. Farbenindustrie A.-G. E.P. 507,538, 16.6.39. Appl. 18.11.37. Manufacture of olefine oxides by the catalytic oxidation of olefines with oxygen or oxygen-containing gases using a silver catalyst activated by a metal of the platinum group.

Boots Pure Drug Co., A. D. Powell, J. C. E. Tait and Lord Wolmer. E.P. 508,125, 27.6.39. Appl. 13.4.38. Preparation of a composition for destroying pests and slugs by forming a paste of metaldehyde and a fatty compound, and baking the same at temperatures low enough to avoid substantial volatilization of the metaldehyde.

T. L. Shepherd. E.P. 508,407, 30.6.39. Appl. 8.3.38. Preparation of an insecticide by mixing 1 part by weight of salol and 3 parts by weight of thymol heated to melting temperature and then cooled. The mixture is dissolved in a solvent, *e.g.*, terpineol or Ti-Tree oil. W. S. E. C.

Detonation and Engines.

1108. British Diesel Engines. *Auto. Engr*, 1939, **29**, 178–185.—A survey of high-speed diesel development and practice during the past year. Many detailed refinements have been introduced, and the study of rate of pressure rise in relation to ignition lag has contributed to smoother running; two-stroke developments have remained slow.

For marine propulsion the displacement of spark-ignition engines continues at an increased rate. In railway traction standard road-vehicle engines are being successfully adapted to multi-unit train arrangements. For road transport there has been a continuation of the trend towards direct injection in order to obtain the best possible fuel consumption. Taxation has hampered the development of small units for the lighter vehicles. It is estimated that 20% of the diesel fuel used by road vehicles is home-produced.

The products of twenty-two manufacturers are described, with illustrations.

K. T. A.

1109. Continental Oil Engines. *Auto. Engr*, 1939, **29**, 186–214.—A review of the trend of design and constructional practice in European countries during the past year. The products of some fifty manufacturers in ten different countries are described, with 83 illustrations. Among the many points of interest the following are, perhaps, the more outstanding: In Denmark the well-known firm of Burmeister and Wain have entered the field of small, high-speed engines with two six-cylinder direct-injection units of 55 and 90 H.P. An unusual design of cylinder head is employed, and each cylinder has its own combined fuel pump and injection valve of Bur–Wain design and manufacture. In Finland O.Y. Ares A/B produce fourteen high-speed marine units, developing from 45 to 520 H.P. All are of the low-compression, spark ignition type (Pohjanpolo patents). The system has been adapted experimentally to a Cirrus aircraft engine.

A number of French manufacturers build engines under British and German licences, but the Panhard road transport engine is unique in having dual sleeve valves. The development of the Clerget aircraft diesels is directly sponsored by the French Air Ministry. There is a fourteen-cylinder air-cooled radial of 600 H.P., weighing 2·53 lb. per H.P. The latest unit has sixteen water-cooled cylinders and develops 1600 H.P.; it is supercharged by four Rateau exhaust-turbo blowers, and a fuel consumption on transatlantic service of 0·375 lb. per H.P. hour is anticipated. The Coatalen aircraft engine has a rated maximum of 575 H.P. with a dry weight of 1100 lb.

German manufacturing programmes show the influence of type rationalization under the Four-Year Plan, and there is marked interest in the use of low cetane fuels. It is claimed that the D.W.K. railcar engine can utilize brown coal tar oil and gas-oil equally well and without modification. Petrol starting systems are used on the Famo and Kämper. Maybach, who have consistently advocated direct injection, have now adopted a pre-combustion chamber system for railcar and marine engines. Phänomen have produced a four-cylinder 60 H.P. air-cooled diesel, whilst the Krupp horizontally-opposed air-cooled engine has disappeared. Of the M.A.N. air-cell engine it is reported that complete control of combustion has been established, and a substantial reduction in the fuel consumption has been effected.

The Italian firm of Alfa-Romeo are developing V-type blower-scavenged two-stroke engines for transport applications. In Switzerland the Saurer toroidal combustion chamber remains unchanged. Sulzer high-speed marine engines are of the opposed-piston two-stroke type, but the single crankshaft has only two throws per cylinder. This is made possible by a system of rocking beams.

K. T. A.

1110. American Oil Engines. *Auto. Engr*, 1939, **29**, 215–222.—It is estimated that there are now about 39,000 American high-speed diesel engines in service; of these perhaps 31,000 are used in tractors and less than 5000 in automotive service. However, it seems likely that from now on the use of diesel engines on the road will increase very rapidly indeed.

An outstanding development in the past year has been the General Motors blower-scavenged two-stroke engine, of which some 700 are already in service. It is produced in three-, four- and six-cylinder units. Scavenge air is delivered by a three-lobed Roots blower. Combined pump and injector units in each cylinder inject fuel through a multi-hole nozzle at 20,000 lb. per sq. in.

In the more conventional types of engine the Lanova combustion chamber is widely used, as in the Buda, Dodge and Mack. Hercules continue to use their own "hot cup" turbulence chamber. The Cummins is still used in automotive service in considerably greater numbers than all other makes combined.

The well-known Caterpillar engine is built in a number of different sizes, all of the pre-combustion chamber type; the sale of this engine is now of the order of 12,000 units per year. Waukesha produce three Ricardo "Comet" type engines for road vehicles, and a range of nineteen engines of the Hesselman type. The latter are, of course, of the low-compression spark-ignition type. K. T. A.

1111. Tables of High-Speed Oil Engines. *Auto. Engr*, 1939, **29**, 223–234.—One of the features of the annual Diesel Number of this journal is the section summarizing the specifications of diesel engines for road, rail and small marine purposes. This year data are given for 195 British and 420 Continental and American engines. The trend of automotive design in the leading countries is apparent from the following summary:

	Number of types manufactured.			
	Turbulence Chamber.	Direct Injection.	Air cell.	Pre-chamber.
Great Britain . . .	20	11	3	—
France	11	11	—	3
Germany	27	8	6	31
Italy	5	4	3	5
U.S.A.	21	7	7	11

The specific fuel consumption of direct injection types is usually about 0·41 lb./B.H.P./hr., except in Great Britain, where the average is 0·36 lb. Other types range from 0·41 to 0·46 lb. In Great Britain 67% of the engines (all types) have a compression ratio between 14·0 and 16·5 in contrast to Germany, where 62% are between 17 and 18 to one. In the U.S.A. 49% have ratios between 14·5 and 15·5, whilst 18% are less than 13 to one. K. T. A.

1112. Vapour Phase Cooling for Internal Combustion Engines. J. H. Wallace and R. A. Newton. *Oil Gas J.*, 7.9.39, **38** (17), 58.—A study is presented of the thermal conditions within the internal combustion engine cylinder and a description given of a new method of cooling termed vapour phase cooling, involving the use of a liquid at or near its boiling point. In tests on a typical four-cycle explosion type cylinder, the following temperatures were obtained: intake air 60° F., end of suction 155° F., end of compression 800° F., firing 4000° F., end of expansion 2588° F. and end of exhaust 1641° F. The heat of combustion is distributed as follows: brake horsepower 26%, engine friction 6%, radiator 6%, exhaust 34%, jacket water 28%. The last item is subdivided into combustion (to the head) 6%, expansion (to the walls and head) 7%, and exhaust (to walls and head) 15%. It is shown that irrespective of the average jacket-water temperature, the water in the upper jackets and heads is at boiling point, while 10/15 times the normal water flow would be required to keep the metal temperatures to within 20° F. of that of the water. High jacket temperatures reduce liner distortion (owing to the smaller temperature difference), increase the mechanical efficiency by up to 10%, but have little effect on thermal or volumetric efficiency, while they reduce moisture condensation in the cylinder with beneficial effects on corrosion and sludge formation.

The ideal jacket-water temperature is obviously near its boiling point, but this cannot be maintained with normal systems owing to evaporation loss from steam bubbles, vapour lock and the difficulty of thermostatic control under such conditions. Systems which have been tried out include (1) the use of an auxiliary condenser to separate the steam, returning the condensate to the system; (2) steam cooling in which a water level is maintained in the jackets and the steam removed and condensed. The entire jacket heat is removed through the latent heat of vaporization of the water on the jacket wall. The cooling liquid circulation is, however, insufficient to prevent the formation of steam or large steam bubbles and thus hot spots are formed.

The vapour phase cooling system which has now been developed consists essentially of a flash chamber in which the jacket water is circulated and from which steam-free water is returned by a pump to the jacket. The circulation rate is maintained at approximately 0·4 gall. per min. per B.H.P. hr. and is sufficient to maintain a temperature difference of not more than 20° F. Very little cooling takes place so that the liquid soon reaches its boiling point, any vapour formed being drawn off the flash chamber, condensed and returned. The advantages of such a system are: (1) any temperature can be maintained by the selection of suitable liquids or mixtures or by altering the pressure; (2) as the automatic control depends entirely on the latent heat of vaporization of the liquid, it is absolutely stable and automatic; (3) efficient cooling is accomplished owing to the constancy of the temperature of the water throughout the entire jacket; (4) the system is completely sealed so that losses are extremely small; (5) the radiator capacity is greatly increased as it is only used for condensing steam.

The results of practical tests indicate the improvement in the condition of the engine and of the lubricating oil after the installation of these cooling systems.

C. L. G.

1113. Present Position in the Development of Producer-Gas Propulsion. H. L. Pirie. *Instn Mech. Engrs J.*, 1939, **141** (4), 365–368.—The problems associated with the use of producer gas (from coal or a solid derivative thereof) are at present being studied by a committee appointed by interested bodies in Great Britain. The author has therefore refrained from quoting controversial matter and confined himself to a statement of the existing position. Gasoline and producer-gas engines both have thermal efficiencies of about 23 to 25%; diesel engines are about 35% efficient. Even though the calorific values of coal and oil are about 14,500 and 19,000 B.t.u. per lb., respectively, the fuel costs of the producer-gas engine are probably lower. There is about 30% loss of power compared with a gasoline engine of the same size.

Only a small number of experimental vehicles are in use in Great Britain, but in France 4436 producer-gas vehicles were in use by 1937; in the same year Germany possessed 1207, whilst a recent estimate shows that about 1500 are used in Italy. In the United Kingdom the fuels most readily available are anthracite and low-temperature coke. The special equipment of a producer-gas vehicle and the larger engine required may increase the unladen weight of a commercial vehicle by 10 cwt.; the fuel for producer gas weighs nearly four times as much as diesel oil, for a given distance. Since goods vehicles in this country are taxed on unladen weight, conversion to producer gas means an additional tax burden and may also have the effect of reducing the legal speed limit. It is concluded that the operation of vehicles on producer gas from coal presents no insurmountable technical difficulties; development in this country is not likely to be rapid in peace time unless the regulations are modified.

K. T. A.

1114. The Producer-Gas Road Vehicle. W. H. Fawke. *Instn Mech. Engrs J.*, 1939, **141** (4), 368–371.—The author, in this paper, has summarized his experience in operating a 31-seat public service vehicle on producer gas for some 36,000 miles. Numerous types of producer are available, but the cross-draught type without any refractory lining is considered to be particularly suitable because of its relatively low weight. The engine must be not less than 33⅓% larger in volume than the gasoline (or oil) engine to produce the same power. At the same time a compression ratio of 8 : 1 is desirable, together with increased turbulence. The equipment of the experimental vehicle is described in some detail. The operation of starting up from cold takes not more than five minutes. The fuel costs for 32,000 miles are summarized thus: Producer gas, £90; gasoline, £253; diesel fuel, £136. There is an additional annual charge against the gas vehicle of £30 for plant cleaning and fuelling. With a suitable anthracite fuel cylinder wear is not greater than in a gasoline or diesel engine. Conversion of existing vehicles, as was done in the case under consideration, is not so satisfactory as the provision of a new chassis with suitable engine and gearing, but the principle of gas propulsion is regarded as sound.

K. T. A.

1115. The Application of Town Gas as a Fuel for I.C. Engines. C. M. Walter, D.Sc. *Instn Mech. Engrs J.*, 1939, **141** (4), 381–386.—Since 1932 the City of Birmingham

Gas Committee has conducted comprehensive experiments to determine the possibilities of coal gas as a fuel for traction purposes. It has been found that the adaptation of existing gasoline engines results in a power loss of about 20%. The effect of increasing the compression ratio was investigated, and it has been found that by utilizing the fuel injection principle the compression ratio can be raised to 16 : 1; thermal efficiencies of a high order can then be realized.

Special storage bottles have been developed, capable of storing 330 cu. ft. of free gas at 3000 lb. per sq. in., the empty weight being 124 lb. per cylinder. From three to seven of these are mounted on the vehicle. A two-stage pressure reducer supplies gas to the air–gas mixer at slightly below atmospheric pressure.

Bench and road tests have been made, using gas of 475 B.t.u. per cu. ft. gross calorific value. When working on the Otto cycle the optimum gas consumption was 27 cu. ft. per B.H.P. hr., with a compression ratio of 6½ : 1; the power output was 85% of that obtainable on gasoline. Using a modified diesel engine, in which gas injection took place during the compression stroke, with 16 : 1 compression ratio the power output was slightly greater than with liquid fuel; the heat input was approximately the same with both fuels.

The economic aspect is analysed on the basis of a fleet of 50 vehicles, each covering 50,000 miles per annum and consuming 0·2 gallon of gasoline per mile. Road tests have indicated that the gas consumption (Otto cycle) per equivalent gallon of gasoline approximates to 265 cu. ft. It is concluded that town gas at 4*d.* per therm can, under certain conditions, compare favourably with gasoline. If the gas is used in high-compression engines with fuel injection, operating costs would be comparable with diesel engines. K. T. A.

1116. New Injection System for Gas Engines. R. A. Erren. *Instn Mech. Engrs J.*, 1939, **141** (4), 386–389.—The author has found it possible with gaseous fuels to take in a full charge of air during the suction stroke and to admit the necessary gas after the suction valve has closed. A higher volumetric efficiency is thereby achieved. Gas admission during the compression stroke is controlled by a rotary valve. Engine-test results for coal gas and hydrogen are quoted in comparison with Otto cycle performance on gas and gasoline. It is claimed that the new system yields increased power with higher thermal efficiency. Hydrogen has been used as an "accelerator" for coal-tar oils not otherwise suitable for combustion in high-speed diesel engines. K. T. A.

1117. Problem of Anti-Knock Fuels. (1). W. Chylinski. *Przem. Naft.*, 10.3.39, **5**, 129–133.—After dealing with the characteristics of the phenomenon of "knock" and the methods used for its measurement, the author proceeds to describe two theories put forward as explanations of the above phenomenon. Ricardo's theory, according to which "knock" is due to an irregularity in the gaseous combustion of the fuel, is dealt with shortly. Herstad's theory, however, based primarily on the assumption that a large percentage of the fuel is present in the dispersed liquid state, is described at length.

Herstad took as a starting-point the fact that "knock" can be reduced and even completely suppressed if the combustible mixture is heated before entering the cylinder. From this he inferred that, under ordinary conditions, part of the mixture entered and remained in the cylinder in liquid form and that combustion took place in two stages: first, combustion of the gaseous fuel, then combustion of the liquid. "Knock," according to this theory, is therefore strongly dependent on the mode of evaporation and combustion of a drop of liquid fuel under engine-temperature conditions.

Following this idea Herstad investigated qualitatively and quantitatively the phenomena of evaporation and spontaneous ignition of a liquid fuel sprayed on to a hot metal surface. It was found that, as the temperature of the metal surface rose, the time of evaporation decreased gradually until a certain minimum point was reached, after which it rapidly increased to a maximum. Further rise in temperature again decreased the time of evaporation. The minimum reached at lower temperatures, was, however, not attained again, even at temperatures where spontaneous ignition occurred. The described minima and maxima seemed to be characteristic

of all examined fuels. By means of a Time of Evaporation/Temperature diagram it is shown that fuels with high octane number exhibit bigger maxima than fuels with low octane number. The shape and form of the droplets varied at different parts of the curve. Near the minimum the droplet thrown on to the heated surface immediately took on the form of a rapidly disappearing small cloud. As the temperature was raised the droplet was increasingly clearly visible until, at the point of maximum time of evaporation it was seen to be enveloped by an insulating layer of gas. This condition was called the " transition " state of the droplet.

The droplet in the " transition " state ignited quietly and its time of burning was found to increase with rising temperature.

While examining the behaviour of petrol and its fractions, Herstad showed that droplets of higher fractions had longer times of evaporation and more pronounced " transition " periods. It was further shown that the smaller the droplet the longer the time of evaporation for a constant amount of liquid and that when the log of the amount of liquid was plotted against the log of the time of evaporation, a straight line was obtained.

A simple linear relation was also shown to exist between the molecular parachors and the maximum times of evaporation of different fuels.

With regard to the octane number a diagram is drawn with two almost identical curves: one showing the increase in octane number of a knocking fuel to which increasing amounts of benzole are added, the other giving the change of the maximum time of evaporation for these respective benzole additions.

The following conclusions are drawn: (1) The fuel exists in the cylinder in two phases, gaseous and liquid, even during the compression. (2) In the liquid phase slow-burning and fast-burning substances, with pronounced and weak " transition " periods, have to be distinguished. The latter have " knocking " properties. (3) The temperature of the cylinder walls has a decisive influence upon whether the liquid burns rapidly in a normal form or slowly in the " transition " state. (4) The kind of surface and metal are important factors because of the part played by interfacial tension. (5) The combustion phenomena depend on the mode of atomization.

E. J. W.

ERRATUM.

Abstract No. 1047 (*September Journal, No. 191*), line 19. For " pentane " read " heptane."

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Geology.

1118.* Geology of Texas Panhandle Oil- and Gas-field. H. Rogatz. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 983–1053.—A description is given of the stratigraphy and structural geology of this field, and a discussion on the lithologic changes in the rocks and oil-producing formations; the oil pools are described with special reference to lithology.

The subsurface geology is treated by counties and is taken in two parts: (1) prominent tectonic features and their effect on production, (2) stratigraphy of each formation, special attention being given to changes occurring throughout the county.

Production in the Panhandle is governed by the situation of the oil-water and oil-gas contacts, which, by regional tilting of the surrounding area, have been shifted from their original horizontal positions. Any porous formation which intersects the zone between the oil–water and gas–water contact surfaces will be productive.

The probability of finding many new shallow oil pools in the Panhandle is thought to be remote, but the likelihood of ultimate discovery of deep oil is such as to warrant considerable exploratory drilling and geophysical work. Areas believed to be worthy of such exploration are outlined.

Many geological maps and sections accompany the paper. G. S. S.

1119.* Geology of Hugoton Gas-field of South-western Kansas. C. C. Hemsell. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 1054–1067.—This field includes parts of Kearny, Finney, Haskell, Grant, Stanton, Seward, Stevens, and Morton counties (Kansas), and Texas County (Oklahoma).

The area is mostly covered with sands and caliche of the Ogallala series (Tertiary). Subsurface rocks—as shown in a type section—include the Dakota Sand (Cretaceous) up to about 450 ft. in thickness, and a thick series of Permian deposits. Important formations of the Permian, met above 2000 ft. from the surface, are the Blaine Gypsum (at about 1000 ft.) and the Stone Corral (Cimarron anhydrite) at approximately 1750 ft. Below these rocks occur shale and anhydrite of the Wellington formation, Upper Summer (225–370 ft.), followed by the gas-bearing dolomites and limestones of the Summer and Chase groups, 200–250 ft. thick. These, the producing horizons, are encountered at depths ranging from 2460 to 2750 ft. and dip approximately 12 to 14 ft. per mile across the Hugoton Field.

The author states that at the time of writing 307 gas wells have been completed in the field, with a daily open flow of 2,277,071,000 cu. ft., averaging approximately 7·4 million cu. ft. per well. G. S. S.

1120.* Summary of Rocky Mountain Geology. J. G. Bartram. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 1131–1152.—This is a brief account of the stratigraphy and tectonics of the Rocky Mountains from the Pre-Cambrian to Recent. All geological formations are represented in the Rocky Mountain area of the western United States, and excellent outcrops enable detailed examination to be made. The author presents his account by the aid of a series of paleogeographic maps and cross-sections.

Four main structural epochs are cited: (1) the formation, in Algonkian time, of the Cordilleran geosyncline, which extended from Utah to British Columbia and remained until the close of the Upper Cretaceous; (2) the extension in the Pennsylvanian and Permian of the Arbuckle–Wichita–Amarillo mountain ranges into New Mexico and elsewhere, followed by erosion and burial under Trias and Jurassic sediments; (3) the uplift of the Cordilleran land mass on the west and south-west, in the Middle Triassic, and (4) the eastward extension of the uplifted folded and faulted Cordilleran highland at the close of the Upper Cretaceous, thus giving rise to the present Rocky Mountains. G. S. S.

1121.* Contribution to Jurassic Stratigraphy of Rocky Mountain Region. R. L. Heaton. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 1153–1177.—A large number of sections of Jurassic sediments have been measured in the Rocky Mountain region. These, together with similar detailed results obtained by other workers, are used in vertical sections for correlation purposes.

Thus, the basal sandstone of the "Jurassic" of northern Colorado is shown to be

probably partly Entrada and partly Upper Triassic. Further, it is shown that the latter grades into red sediments southwards, and the former continues into New Mexico, where it is identical with the so-called Wingate. The true Wingate of the Zuni Mountains merges laterally into red beds, and may be Upper Triassic in age.

Lithologically, the Entrada is unlike the Wingate both in colour and method of weathering. The Entrada weathers to rounded forms, is almost jointless, and is banded in grey and pinkish colours. The Wingate is distinctly columnar-jointed, forms vertical blocky cliffs, and is deep red in colour.

Maps, sections, and photographs illustrate the paper. G. S. S.

1122.* **Environments of Origin of Black Shales.** W. H. Twenhofel. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 1178–1198.—Many theories exist regarding the origin and environment of black shales, and certain of these are reviewed and discussed.

Black shales were obviously black muds before lithification, or compaction, and this colour is largely caused by the presence of organic matter: black monosulphide of iron and the black oxides of manganese are also contributors in this connection. Muds that are black at the time of compaction because of organic matter or manganese, remain so after compaction. Black ferrous sulphide in muds, however, renders them light-coloured on compaction, as this sulphide alters to either marcasite or pyrite.

Organic matter may be composed of plant fibres, or it may be present in a very finely divided state, and at the time of deposition was evidently of colloidal dimensions. Some organic matter originally of this nature occurs in all black shales. Again, other black shales contain spores and pollen grains, and some are filled with remains of fatty algæ—these materials originally carried a high percentage of fats, waxes, etc.

Sediments associated with humic black shales are mainly continental in origin, consisting of sandstones, coals, and limestones; some beds may be of marine origin. Environment appears to be similar to that in the accumulation of vegetable matter resulting in coal.

The conclusion is that black shales originate under a number of environmental conditions: for example, in land waters (lakes and ponds), in deep sea-water extensions of the ocean (Black Sea), shallow marine waters (lagoons, bays), and over mud flats of lagoons, estuaries, and deltas. G. S. S.

1123.* **Mississippi Well is Flowing Oil.** N. Williams. *Oil Gas J.*, 7.9.39, **38** (17), 25.—It seems almost certain that commercial oil production has been found in Mississippi about 10 ml. south-west of Yazoo City. The oil sand is 10 ft. thick and 4540 ft. deep. It has a porosity of 25% and is in the uppermost part of the Cretaceous. The oil is of asphaltic base and 34·2° A.P.I. gravity. The area was selected on the basis of reflection seismograph work and also on surface structural evidence.

There have been few favourable showings of oil in all the wildcatting in Mississippi. Three outlying wells of the Jackson gas-field have given small amounts of very heavy oil intermittently with salt water, from the Selma Chalk. Evidences of oil have been found at Collins, Covington County, in the Wilcox; Hiram, Wilkinson County, in the Cockfield; Quitman, Clarke County, in the Eutaw; and in the Amory area of north-eastern Mississippi. Two salt domes were discovered in South Mississippi in 1937.
G. D. H.

1124.* **New Pays Prolific as Revival Continues in Creek County.** D. Dalrymple. *Oil Gas J.*, 7.9.39, **38** (17), 25.—Active development in the county began in 1906 following the discovery of the Glenn pool in 1905. In 1912 the Cushing pool was opened, followed by the Bristow–Slick area. In addition to these major fields, many smaller pools were discovered. Activity waned with the decline of the principal fields, but in the last two years there has been a revival of drilling. Several small pools have been opened, some of the older areas have been extended, and some success has been obtained with re-working, plugging back or deepening old wells in the Drumright–Shamrock and other areas.

The Zoller or Central Commercial pool, opened in 1938, found gas in the Bartlesville at 2521 ft. and oil at 2532–2552 ft. The oil flowed at 12 brl./day and gas at 3,500,000 cu. ft./day. Seven wells have been completed in the Bartlesville sand. The Dutcher and other horizons have yet to be tested.

1½ ml. south-west of the Zoller area is the Strozier pool. This, too, produces from the Bartlesville and may cover more than 100 acres.

In Township 17–9e production has been found in the Oswego lime and the Dutcher sand. The Dunn pool found oil in the Misener and the Wilcox. The Leverett pool yields oil from the Bartlesville, and Wilcox production has been found in a new area in the South Manford district. Furthermore, there have been discoveries in Sections 24 and 25–18–9 (Wilcox), Section 13–17–10 (Red Fork and Taneha), Sections 4–17–10 and 33–18–10 (Dutcher) and Section 30–14–7 (Prue sand). G. D. H.

1125.* Wasson–Denver–Bennett is Now One Big Field. R. M. Sanford. *Oil Gas J.*, 14.9.39, **38** (18), 26, 34.—The Wasson–Denver–Bennett field, started in several widely separated spots, has, after two years' drilling, an estimated proven area of 43,000 acres and an estimated oil reserve of about 344,000,000 brl. It is not yet fully defined. The productive Permian lime is about 5000 ft. deep.

The discovery wells of the three original fields were not less than 6 ml. apart. At the beginning of September 1939, there were 398 wells in the field. G. D. H.

1126.* Sandoval Devonian Structure. K. A. Spitznagle and H. Moore. *Oil Gas J.*, 14.9.39, **38** (18), 23.—The structure of the Devonian lime at Sandoval is now thought to have a north–south axis. This runs parallel with the main grain of the west side of the Illinois basin. The pay horizon, which is highly porous, lies 36–51 ft. below the Devonian erosional surface, and consists of a very soft, brown dolomite. There is at least 80 ft. of proven productive closure above the water-table. G. D. H.

1127.* University Lease is Louisiana's Second Most Active Area. N. Williams. *Oil Gas J.*, 21.9.39, **38** (19), 62.—This field is in East Baton Rouge Parish. The productive area, in which about thirty-five wells have been drilled, is about 1 ml. from north to south and 1½ ml. from east to west. Dry holes have been drilled on the extreme north-east, the west and south-west, the south and south-east sides. The outlying dry holes are structurally higher than any of the wells in the producing area, pointing to the field being on the downthrown side of the bordering faults. The first well found the producing sand at 6450 ft., and other oil and gas shows. A spacing programme of one well to 10 acres has been adopted.

The oil zone is 10 to 12 ft. thick and fairly uniform throughout the field. It is of Miocene age, as is also a gas sand found at about 4340 ft. The wells have potentials of 300–500 brl./day on ¼ to $\frac{1}{16}$ in. chokes, with pressures ranging from 1000 to 2250 lb./in.^{2} G. D. H.

1128.* Pratt County, Kansas, Scene of Revived Exploration. D. Dalrymple. *Oil Gas J.*, 28.9.39, **38** (20), 20–21.—In the eastern part of Pratt County recent developments indicate the joining of the Cunningham and Cairo pools into one major gas- and oil-field. The No. 1 Royse well lies 1½ ml. east of the nearest Cairo production and 2¾ ml. south-west of the nearest Cunningham production and gives 1,110,000 cu. ft. of gas daily from 4268 ft. This and other gas wells produce from the Viola lime, whilst a well with a potential of 772 brl. of oil/day has been completed in the Lansing lime at 3402–3458 ft.

The Cunningham field was opened in 1931 with Lansing lime oil production at 3385–3441 ft. In 1932 Arbuckle lime production, mainly gas with a little oil, was found at 4093–4175 ft. Later a well plugged back to 3922 ft. gave 52,000,000 cu. ft. of gas daily from the Viola lime. Due to careful reservoir control, nearly all the wells flow. Gas from the Admire shale is used for repressuring. A number of other horizons show gas.

The Cairo sector was opened in 1937, when a well gave 10,000,000 cu. ft. of gas daily from the Viola lime at 4278 ft. The two fields cover about 10,000 acres.

The Luka pool has Simpson dolomite oil production. G. D. H.

1129.* Loco Hills Field is Most Active in New Mexico. D. H. Stormont. *Oil Gas J.*, 5.10.39, **38** (21), 23.—This field, discovered in January, now has producers scattered over a semi-proven area of 4500 acres. Oil is relatively shallow (2600–2800 ft.). The

productive limits are apparently defined on the south-west and west sides, and on the north and north-west sides several dry holes have been drilled.

Production is obtained from the " Artesia " sand pay (Permian), with accumulation apparently due to lensing out of the sand to the north and west on lime highs, forming an embayment. The regional dip is to the south and east at 60–70 ft./ml. The oil sand thickness ranges from 30 ft. well within the field to 12 ft. in the north and west.

A well which missed the Loco Hills pay entirely is being completed as a producer in a lime section at 3252 ft.

At present the producers have an allowance of 65 brl./day. G. D. H.

1130.* New Discovery in Burkburnett Starts Redrilling Activity. R. M. Sanford. *Oil Gas J.*, 5.10.39, **38** (21), 33.—4½ m.l. south-west of the town of Burkburnett a new oil-field of some twenty-five wells has started a redrilling and re-exploration campaign in the Burkburnett, Clara, and other old shallow fields in the northern part of Wichita County. It is thought that twenty years ago in the rush to tap the prolific Burkburnett sand shallower sands may have been ignored.

The new Warren and Reilly area has given a 150-brl. well from 20 ft. of sand at 1362 ft., and a 29-brl. well at 800 ft. The deeper production is better, and the field is of typical lenticular type. At present it covers little more than 80 acres.

A number of comparatively deep wells were drilled in this area during the past ten years, but all were dry. G. D. H.

1131.* Drilling Activity Assuming Boom Proportions in Golden Meadows. N. Williams. *Oil Gas J.*, 14.9.39, **38** (18), 24.—Golden Meadows is the most active spot in Louisiana despite disappointing results in the development of production. There appears to be a badly faulted and irregular sand condition, and although there are at least nine sands at depths of 2600 ft. to over 10,000 ft., and 12–30 ft. thick, they are extremely segmentary, with very spotted productivity. All the sands are not present in all the wells and only four have given commercial production. The side of a fault on which a sand is found seems to have nothing to do with its productivity. The zone of oil saturation in the sands generally does not exceed 5 ft., and it is difficult to exclude water completely. The spotted accumulation has been attributed to the sands being fed from a common source via the faults.

To date ten producing wells have been completed, although eight other tests have been drilled below present producing horizons.

The history of the development of the field is described. G. D. H.

1132.* Mesozoic and Cenozoic Most Important Texas Producing Zones. M. C. Dalton. *Oil Wkly*, 2.10.39, **95** (4), 24.—All oil-fields located in the south, east, and Gulf Coast areas of Texas are producing from Mesozoic and Cenozoic formations. The Balcones fault zone roughly separates Mesozoic and Cenozoic oil-producing fields in Texas from those producing from the Palæozoic. In Texas seventy-three fields produce from the Mesozoic and 214 from the Cenozoic. On the Gulf Coast all the fields produce from the Cenozoic, whilst in East Texas production is predominantly from the Mesozoic. In East Texas the main producing horizon is the Woodbine sand.

The history of oil development in Texas is briefly outlined and a graph shows the number of fields discovered each year. The peak year was 1937, with forty-nine new fields. A table summarizes the modes of discovery of the fields in the various regions of Texas.

There is a definite trend towards deeper drilling in all the areas under consideration. In East Texas Lower Cretaceous beds of Glen Rose age are being penetrated. In South Texas exploratory drilling has gone below 10,000 ft. Generally production on the Gulf Coast is deeper than in the other two areas, although there are some very shallow fields. This latter area offers good opportunities for successful deep drilling. There the Frio formation is of major interest, and the underlying Cockfield, Upper Saline Bayou, and Lower Saline Bayou are possible favourable deep producing sands. A table summarizes the number of fields producing from various depths, whilst a further table classifies the fields according to the type of structure. Domal structures are commonest on the Gulf Coast, whereas sand lensing predominates in South Texas. Monoclinal producing structures are rare, but faults are very important. Terracing

is of minor importance. In South Texas eight fields are associated with igneous intrusions.

The fields have been classified according to the type of producing formation. The dominant lithological type is sand. A generalized columnar section of the Mesozoic and Cenozoic of Texas has been constructed, and on it the stratigraphic positions of the producing fields are shown. G. D. H.

1133.* Simple Device for the Construction of the Trace of the Axial "Plane" of a Competent Fold. G. D. Hobson. *Geol. Mag.*, Sept., 1939, LXXVI, 427–432.—If the form of a fold is known, but not the centres of curvature of the components of the curve, it is not a very simple matter to locate those centres in order to determine the trace of the axial "plane" according to Busk's method. The instrument described consists of a plane, vertical, metal mirror, to the bottom edge of which is attached a graduated strip which is extended horizontally along the line of the mirror edge. The zero mark of the scale, etched on the mirror, is set on the curve, and the mirror is rotated about this as vertical axis until the curve and its image appear to run smoothly into each other. The edge of the scale is then along the normal to the curve at that point. In this way, by alternate application to the two limbs of the fold, generally at pairs of points on each limb, it is easy to locate a series of points which are equidistant from the two limbs, and they lie on the trace of the axial "plane."

G. D. H.

1134.* Alberta Oil Progress in the Half-Year. J. L. Irwin. *Petrol Times*, 12.8.39, XLII, 201.—The production in the first half of 1939 was 3,254,000 brl., an increase of 424,000 brl. over the corresponding period of 1938. The production history since the beginning of 1936 is briefly described.

A new refinery was opened in East Calgary in May.

Drilling at Steveville, 150 ml. east of Turner Valley, has given a gas flow of 12,000,000 cu. ft./day with 0·15 gal. of gasoline/1000 cu. ft., which is almost commercial production. At Pouce Coupe, which lies within 430 ml. of the Pacific, an extensive drilling programme has been arranged. 150 ml. east of Edmonton, wells at Lloydminster have shown encouraging recoveries of oil and gas at depths of 1925 and 1751 ft. Wells are being drilled at Vermillion, 25 ml. west of Lloydminster. On the Kootenay dome a well has penetrated 800 ft. of Devonian limestone and encountered promising gas strikes. The Ram River and Clearwater wells, also Devonian tests, have found gas. Information is given regarding wells in other areas.

The bulk of Turner Valley's production now comes from the south from an area 5 ml. long and 1 ml. broad. The productive zone seems to extend from the gas area in the east to the sudden dip in the structure. Turner Valley's prospects seem very bright. G. D. H.

Geophysics.

1135.* Advancements in the Use of the Gravimeter in Oil Exploration. L. M. and F. W. Mott-Smith. *Petrol. Engr*, Midyear 1939, **10** (10), 85.—To be of value for oil exploration the instruments must be capable of measuring about 1 ten millionth of the total acceleration of gravity. They consist of a mass supported by an elastic member, and a means of measuring differences in the position of the mass caused by variations of the gravitational attraction. The constructional and operational problems are described.

For reconnaissance work one station per square mile may suffice, but for detail ten may be required. Bases and subsidiary bases are used for checking the behaviour of the instruments after every five to ten observations. The instrument readings are converted to milligals by means of a calibration curve, and a drift curve is plotted showing the gravity values against time of reading, the repeat values at the various bases and subsidiary bases showing the drift and serving as a check on instrument operation. In this way the gravity differences for the various stations can be obtained. Before plotting on a map, elevation and latitude corrections must be applied. Gravity contours are then drawn. An example is described and discussed.

The value of a gravity map depends on its accuracy. There are three principal causes of error: (1) Erratic fluctuations in instrument reading from such causes as

temperature variation, elastic after-effect, jarring, etc. The probable value of this error can be determined by tests. (2) Inaccuracy of calibration curve. This may be tested against pendulum observations. (3) Errors in making latitude and elevation corrections caused either by inaccurate surveying or by the use of an incorrect elevation correction constant.

The accuracy of gravity maps obtained with a torsion balance depends more on the character of the terrain than does that of those obtained with a gravimeter. The torsion balance being more strongly affected by nearby terrain irregularities, the gravimeter is more effective in irregular territory. The torsion balance is probably more suitable for detecting small-scale shallow structures, whilst the gravimeter is probably at an advantage with larger anomalies. A gravimeter is probably about ten times more rapid in operation than a torsion balance, and hence the cost per square mile is considerably lower. G. D. H.

1136.* Probable Discovery Rates in the Gulf Coast Area. V. G. Gabriel. *Oil Wkly*, 11.9.39, **95** (1), 46.—Tables are given showing the results achieved by seismic and torsion balance exploration in the Gulf Coast area prior to the middle of 1938. The information includes the location of the oil-field, the date and means of its discovery, the amount of oil produced, the ultimate oil recovery, and the amount of oil which can be credited to seismic or torsion balance methods. The probability table gives some data pertaining to discovering oil- and gas-fields and wells under various conditions, chiefly in the Gulf Coast area. There is a marked improvement from year to year in the chance of discovering oil, and the high value of combined geological and geophysical information in " wildcat " drilling is demonstrated.

It is estimated in the periods 1925–1938 and 1935–1937, that 65% and 76%, respectively, of the oil discovered can be attributed to geophysics. The balances fall to geological discoveries. The average cost of a geophysical discovery is computed to be $0·023/brl. of oil. G. D. H.

Drilling.

1137.* Augering and Core-Drilling in Trinidad. E. C. Scott. *J. Inst. Petrol.*, 1939, **25**, 501–508.—A paper presented at the Trinidad branch which describes the use of four main types of rotary machines used in this type of drilling and the scope of the work. G. R. N.

1138.* Method for Handling Drill-Cutting Samples at Well. D. H. Stormont. *Oil Gas J.*, 6.4.39, **37** (47), 45.—An efficient method of handling rotary drill cuttings is described. The equipment for sampling, washing, and drying the cuttings is of an improvised nature, but takes representative samples of the returns with uninterrupted service. The sample is collected in a pan, washed, and finally dried in a steam-jacketed 3-in. pipe, utilizing cheap material and exhaust steam throughout. The installation is both economical and simple. A. H. N.

1139.* Combination Drilling Method Used at Van Horn, Michigan. H. F. Simons. *Oil Gas J.*, 13.4.39, **37** (48), 34.—A saving in time and in cost of drilling wells in the Van Horn field is effected by drilling a little more than one-third of the well by the rotary rig, whilst drilling the remaining depth of the well and completing it by the cable-tool method. A detailed description of the formations encountered, the drilling programme, and difficulties is given. A. H. N.

1140.* Review of Illinois Basin Operating Problems. R. E. Damp. *Oil Gas J.*, 13.4.39, **37** (48), 44.—The rotary method was the principal one used for exploration and exploitation of oil and gas in the Illinois Basin. Some 2046 wells were drilled, of which 1910 were productive in 1938. It is estimated by the A.P.I. that 208 million brl. reserve have been discovered in the same year.

The new rotary rig is of a light type, which has a limit of 3000 ft. using 4½-in. drill pipes. Most contractors use the following sizes of machines and other items: rigs powered with two gasoline, semi-diesel, or diesel engines, from 80 to 175 h.p.;

pumps, from 5 × 10 to 7¼ × 14 ins.; drill pipe, 4½-in.—3½-in. may be used in certain cases, whilst some wells were drilled using D.P. 2⅞-in. and setting 4½-in. O.D. casing. Cost per ft. has been lowered, and averaged $1·75 for 6¼-in. to $3·50 for 8¾-in. hole up to 3000 ft., excluding casing and cement. Drilling time has also been reduced. Casing strings have been lighter and smaller than previously. Fast-setting cements have been in general use, with a minimum setting time of 48 hr. To obviate excessive pressures being encountered when using light-weight pipe and circulating cement, Aquagel has been added, with good results. A 3%-by-weight Aquagel-cement lightens a 15-lb. slurry to about 13·5 lb., and has about the same viscosity.

Cores have been taken in the first wells, whilst in the later wells electrical logging has been used, resulting in appreciable saving.

Whether well completion by rotary or cable-tool methods is preferable is still a debatable question. While shooting has been practised, acidizing has been improved and used. In one method a flexible tube has been run on the end of a "macaroni" string, through which acid is pumped to impact at the formation at high velocities, destroying the lime and allowing the flexible tubing to project out into the formation. In a test it was possible to reach 42 ft. laterally. Packers and retainers have proved valuable assets in acidizing tight formations. The size of treatment ranges from 500 to 10,000 gal.

Removable lines have been used to produce two or more formations in the same well. They are run in the string of casing, and are removed by a special pilot bit or with a well scraper, and, in the case of a recent metal alloy, by acid. It was found that these liners should be placed with shoes on top and bottom of the liner, the shoe on the bottom being inverted.

It is believed that in pumping wells electricity will undoubtedly be the source of power. Individual pumping units range from 3·5 to 7·5 h.p.

Pressure maintenance is being practised in two basin pools. Original reservoir pressure in the Louden pool was about 650 lb. and is at present about 580 lb. Gas returns to the sands at 650–750 lb. and in sufficient quantities to maintain a low rate of decline in reservoir pressure. Gas injection will be slow, in order to avoid creating gas caps. Input wells are located in the centre of eight producing wells in each quarter section and the adjoining quarter section. A. H. N.

1141.* No Limit Yet to Deeper Drilling in the Gulf Coast. N. Williams. *Oil Gas J.*, 20.4.39, **37** (49), 105.—A record is given of the deepest wells drilled in the Gulf Coast. Data are supplied in the text and in tables regarding the records broken in recent years by producing and non-producing deep wells. A. H. N.

1142.* Many Unusual Features in Rig Design Reported on Louisiana Discovery. N. Williams. *Oil Gas J.*, 20.4.39, **37** (49), 114.—The rig was assembled with a view to expediting the carrying out of a comprehensive development programme in coastal Louisiana. As an exploratory test, the Kenilworth well has been drilled to a total depth of 11,469 ft. Oil and gas sands have been encountered below 10,500 ft.—chiefly between 10,532 and 10,960 ft., and several below 11,190 ft. Seven-inch casing was cemented on bottom and perforated. The well was completed by perforating an 18-ft. section at 10,608–26 ft.

From 8401 ft. to bottom six Schlumberger surveys were run, and every formation was tested as thoroughly as possible.

The world's second longest string of 9⅝-in. casing was run and cemented in 15 hr. 36 min. The string was 10,807·94 ft. long and 483,673 lb. (241·8 tons) in weight. Going from bottom upwards the string consisted of one Baker high cement upwhirler float shoe; two joints of 47·60-lb. NGCR-2 flush-joint casing; one Baker Baklu cement float collar; ninety-six joints of 47·60-lb. NGCR-2 flush-joint casing; one combination joint; 183 joints of 43·50-lb. NGCR-3 speedite casing.

Drilling mud was reconditioned before running in casing.

Record time was also made in running and cementing the 7-in. flow string. Details are given of operational times in both cases. No difficulty was experienced in cementing.

In setting the surface 13⅜-in. casing two clamps instead of the usual one were employed below the collar. A heavy preventer and drilling control were necessarily

used. The assembly was placed in the 9 × 9 × 9-ft. cellar under the derrick floor.

The steel substructure is the first of its kind, and provides ample working clearance. The rotary table sills are supported in it by longitudinal beams, on which the entire length of the rotary skids rests. The beams rest on columns 12 ft. apart. They are only 16 in. high instead of 24 in., and consequently give an additional 8-in. clearance.

The rotary table support is, unusually, independent vertically of the remainder of the structure. Also steel floor sills are used instead of the wooden ones in common practice. The substructure includes a wood-covered steel ramp with a capacity to take the draw-works (60,000 lb.) with a drum full of line. The engine substructure is also of steel.

Derrick is of 136 ft. by 30 ft. base size, with a 15-ft. gin-pole and a platform extending the entire length of the gin-pole cross-beam.

The weight indicator is placed on a 3-in. pipe which extends through a hole in the platform to the concrete substructure. None of the vibrations in the derrick can be transmitted to the weight indicator.

The deadline tie-down is made through a 2½-in. U-shaped pipe grouted in the concrete; thus only little wear is possible on the wire, and the strain is taken off the derrick leg.

Sizes and weights of equipments were designed so that no single unit would have a greater size, weight, or capacity than could be effectively utilized in co-ordination with the operation of other units. A. H. N.

1143.* Illinois Drilling Rigs. H. F. Simons. *Oil Gas J.*, 27.4.39, **37** (50), 38.—The shallow wells of the Illinois Basin require a technique of drilling different from that used in deep-well drilling in Texas, Oklahoma, and Kansas. Due to the formation, particularly the Pleistocene, being loose and unconsolidated, much cement is lost, and this necessitates smaller holes and clearances between casing and wall. Hence much pipe-sticking occurs. In many cases it is cheaper to abandon the well, skid the rig, and redrill than to follow a fishing programme, as drilling the hole takes 100 hr. or less. Smaller pipes are now used to reduce sticking, the resultant loss of weight on the bit being made up by lengthening the collar. Damage to drill pipe still constitutes one of the principal costs of drilling in Illinois. Speeds are consequently reduced from 120 r.p.m. to 75–90 r.p.m.

In completing the wells many operators are using removable alloy pipes opposite the Weiler zone. Shooting continues to be the customary treatment for sand wells. A. H. N.

1144.* Applying High Explosives in Completing Oil Wells. B. Altman. *Oil Wkly*, 15.5.39, **93** (10), 28.—The object of shooting wells is to increase the permeability, to enlarge the hole, to clean the face of old pumping wells, and to straighten crooked holes —in short, to increase production. Shooting is also applied as a last resort before abandoning a well.

Three types of explosives are used: blasting gelatin, liquid nitroglycerin, and gelatin dynamite. Straight dynamite is not suitable, as water affects its properties.

After briefly describing different methods, it is pointed out that in shooting limestone to open new channels, it has been found from experience that the highest concentration gives the best results.

Many factors must be studied before deciding upon using solid or liquid stemmings. Solid stemming confines the reservoir energy to a greater extent than liquid stemming, increases the size of the shot hole, and reduces the number of casing failures. In liquid stemming oil is preferable to water, as oil absorbs the shock more effectively. Diagrams are given of probable shapes of shot-holes with different stemmings and points of detonation.

Solid stemming should always be placed on a bridge, usually of broken bricks. It can take the shocks from the hailer without danger of premature explosion, and will confine the shot energy downwards.

In preparing to shoot a well, the hole should be cleaned, the fluid level or oil/water contact level determined, and the temperature of the well taken. Temperatures in the neighbourhood of 140° F. have produced pre-detonations. All the stemming material and bridging should be ready. If liquid explosives are to be used the container should be tested for leaks. Detailed considerations should be taken of the

weight, size, and kind of casing, total depth of hole, and size of shot before deciding on the kind and extent of stemming.

Much scientific research is required before this art of oil-well shooting can be thoroughly understood. A. H. N.

1145.* Study of Physical Properties of Rotary Drilling Muds. F. G. Tickell and M. H. Stekoll. *Oil Gas J.*, 11.5.39, **37** (52), 56.—The purpose of this paper is to describe those physical and mechanical properties of drilling muds which should be correlated with the kinds and amounts of chemicals added. The effects of treating three varieties of natural muds with sodium tannate are given and correlations of properties discussed. The properties are: (1) Apparent viscosity as shown by a Stormer viscometer. (2) Gel strength at 0, 10, 20, and 90 min. as shown by weight required to start motion in a Stormer viscometer. (3) Yield point as shown by a special simple apparatus. (4) Thickness of filtrate cake and volume of filtrate expressed as shown by a small hydraulic press and piston-and-cylinder type of pressure filter (1000 lb./sq. in.). (5) Percentage of water separating from mud in 24 hr. as shown in a graduated cylinder. (6) p_H value as shown by a Leeds–Northrup glass electrode and potentiometer. All tests were made at room temperature. Graphs are given correlating the amount of chemical used, time elapsed, and effects observed on each of the various items mentioned. By studying all the graphs together the different items are correlated. A. H. N.

1146.* Fishing Job on Kansas Well Cleaned Up by Cutting Pipe. H. F. Simons. *Oil Gas J.*, 18.5.39, **38** (1), 58.—A detailed description of fishing a stuck pipe is given. A. H. N.

1147.* Satisfactory Service of Rotary Drill Pipe is Dependent upon Care in Operation. H. F. Simons. *Oil Gas J.*, 25.5.39, **38** (2), 48.—Care and thorough understanding of drill pipe are much more essential nowadays than formerly, as speeds and weights are used far in excess of old practices. Speeds up to 400 r.p.m. have produced difficulties and dangers which have to be taken fully into account in designing the drill pipe. Longer collars are more widely used than previously. The author discusses these and other problems, such as weight on bit, derrick alignment, tool-joint threads, corrosion, etc., which have to be considered if a long and useful life is to be expected of a drill pipe. A. H. N.

1148.* Design of Casing Programmes. J. O. Hills. *Oil Gas J.*, 25.5.39, **38** (2), 60.—The importance and cost of casing programmes justify careful engineering design based on the best available information on strength and loading conditions. A method of design is outlined which considers actual conditions, and which results in a consistent compromise between economy and safety. Factors influencing choice of sizes, weights, grades, etc., are discussed; method of tabulation is shown; and an example of the design is included. Collapse and tension data in Table I are given primarily to illustrate the method, but are believed to be the most reliable available at the moment. A. H. N.

1149.* Preliminary Evaluation of Factors Controlling Rate of Penetration in Rotary Drilling. J. E. Brantly and E. H. Clayton. *Oil Wkly*, 22.5.39, **93** (11), 15.—An exhaustive study of questionnaires, tour reports, bit records, and formation records has been made on more than 500 wells in typical fields of Texas, Oklahoma, Louisiana, California, New Mexico, Wyoming, and Kansas in order to ascertain the relative influence of four factors on the rate of rotary-tool penetration during the past eight years. The four factors are: personnel and equipment, rotary speed, volume of drilling fluid, and weight on bit. Detailed analyses of these factors are given in both tabulated and graphical forms, the analyses being for both single and composite effects. It was found that improvement in personnel and equipment had a relative effect of 55·5%, as compared with rotary speed effect of 39·6% and drilling fluid volume of 28·6%. The weight on the bit was included in the three preceding factors, as it was quite impossible to separate it from "personnel." Rotating speeds and fluid volumes have apparently reached their maximum limits, as has weight on the bit in many cases.

It was also concluded that an increase in value of each of the four factors will result in increased rates of penetration when drilling soft material with rock-bit or softer still with drag-bit. A limit undoubtedly exists for all these factors except personnel.

In plastic formations, brittle shales, etc., it appears that the upper limit for the weight on the bit has been reached. Increased rates of penetration may be attained by improving the other factors and by using higher pressure jetting from the fluid nozzles of the bit.

In plastic, clayey, silty, and shaley formations, rate of penetration increases depends largely on increased fluid volumes, jetting action, and character of fluid. Use of proper short drag-bits is assumed.* A. H. N.

1150.* Selective Exclusion of Fluids from Wells. P. D. Torrey. *Oil Wkly.* Appearing in seven successive parts. Pt. I, 22.5.39, **93** (11), 26; Pt. II, 29.5.39, **93** (12), 36; Pt. III, 5.6.39, **93** (13), 40; Pt. IV, 12.6.39, **94** (1), 17; Pt. V, 19.6.39, **94** (2), 24; Pt. VI, 26.6.39, **94** (3), 6; Pt. VII, 3.7.39, **94** (4), 30.—The paper is devoted primarily to modern methods which are employed in the completion of oil wells, and in re-working jobs when these may be necessary.

Squeeze cementing, which is used widely as a completion and remedial measure, is a process whereby cement slurry is forced, or "squeezed," under pressure into or against a permeable formation, either in open hole or through gun perforations in the casing. Breaking down the formation by water under high pressure before the cement is introduced seems to be a prerequisite to the success of squeeze cementing. It is believed that openings in the formation are formed by the water under pressure, which provides spaces—sometimes of considerable size—in which the cement may lodge. Evidence is presented that would indicate that cement will set preferentially in a gas pay or a water sand rather than in an oil sand, and that in ordinary circumstances the cement has no detrimental effect on the oil sand.

Methods employed in squeeze cementing with and without a cement retainer are described. An interesting method for the testing of a deep wildcat well, without the running of a long string of casing, by cementing a short string opposite to the horizon to be tested, is described. A description is also given of a method that has been developed for the completion of a well producing from a series of oil sands through one string of casing.

Case histories in various fields of Texas, Louisiana, Arkansas, and Illinois, where squeeze cementing has been employed for the reduction of high gas–oil ratios and for the exclusion of water, are presented. Maximum squeeze pressures in excess of 3000 lb. per sq. in. appear to give the best results for the reduction of high gas–oil ratios, and maximum squeeze pressures of approximately 4000 lb. per sq. in. appear to give the best results for the exclusion of water. Squeezing in close proximity to the gas–oil or the water–oil contact is essential. Squeezing is generally much more effective through gun perforations in the casing than in open hole. Of the various records studied, 44% were entirely successful in the reduction of high gas–oil ratios, and 61% were entirely successful in the exclusion of water. The employment of higher maximum squeeze pressures, gel types of cement, and multiple-batch jobs is increasing the percentage of success that is being obtained from squeeze cementing. The results from squeeze cementing may not be permanent when readjustments are made in the gas–oil and water–oil contacts in the reservoir.

Various plug-back methods for the exclusion of water are described, and particular reference is made to results that have been obtained in various West Texas fields, in the Rodessa field, and in the East Texas field. No squeeze-cement job for the exclusion of water has been entirely successful in the Permian lime-fields of West Texas. In the Rodessa field very good results have been obtained by cementing a short string in the bottom of the hole and then gun-perforating for production. Many plug-back methods have been used in the East Texas field, but no one method appears to be universally applicable. Past experience has shown that about 50% of the attempts made have resulted in failures. New technique in placing the cement so that the casing may be protected from excessive pressure, and the use of gel types of cement, have indicated more promising results.

Owing to low allowables and the use of small-size chokes, there does not seem to be any great difference in the productivity of wells completed by gun perforation and of those completed by the setting of conventional liner and screen. Gun-perforated

well completions permit a close control of oil production, and provide an easy means for remedial work at some future time. Completions by setting screen and liner may result in larger ultimate oil recovery, and are used widely in thick-sand sections where there is no question as to the water–oil or gas–oil contact.

New chemical methods for the exclusion of water are assuming considerable importance. Two different processes are described, and some of the results that have been obtained are listed. The gel-plugging agent has been applied very successfully in hardrock fields for the exclusion of water. A. H. N.

1151.* Economic Study of Slim-hole Drilling in the Gulf Coast. I. W. Alcorn. *Petrol. Engr*, May, 1939, **10** (8), 25–30.—The paper gives a breakdown and analysis of costs derived from factual data which indicate the feasibility of exploratory slim-hole drilling for testing deep Gulf Coast structures. Data on the drilling of extra large (18¾-in. surface casing), normal holes (10¾-in. surface casing) and slim-holes (7⅝-in. or 8¼-in. surface casing) are analysed. The result is to show that drilling of exploratory small holes has been sound practice, and that its economy is a big factor in its favour.

In general, the chief difference between the operations of drilling a large hole and a small one is that for the same depth a larger number of cubic feet of earth must be removed from the former than from the latter. From this analysis it is seen that, for similar drilling conditions, the rate of drilling or time required to drill to a given depth varies as the square of the diameter of the hole after the surface casing has been set. Hence the slim hole is distinctly a saver of time and, therefore, of money. The author finds reason for believing that slim holes can be drilled to a depth of 9000 ft. at an average cost of between one-third and one-fourth that of the average conventional exploratory well, assuming average drilling conditions and the use of a diesel mechanical rig.

This low cost makes it possible to drill several holes on a prospect to determine the general geological conditions, so that a conventional deep test may be located more rationally. A. H. N.

1152.* Drilling Patents. L. A. Gauthey and W. C. Kaykendall. U.S.P. 2,152,628, 4.4.39. Appl. 23.7.37. Rotary well drilling bit.

G. A. Smith. U.S.P. 2,152,671, 4.4.39. Appl. 26.10.35. Well-surveying instrument.

R. C. Baker. U.S.P. 2,153,034, 4.4.39. Appl. 10.10.36. Cementing casing shoe with radial passage-ways extending from the central passage-way to the outside.

C. E. Burt. U.S.P. 2,153,035, 4.4.39. Appl. 21.1.37. A method for casting slips for oil-well tools.

M. G. Featherston. U.S.P. 2,153,079, 4.4.39. Appl. 27.10.37. A wire splicer which twists the end of a wire upon itself.

J. H. Schumacher and W. C. George. U.S.P. 2,153,680, 11.4.39. Appl. 30.1.36. Direction control mechanism for rotary well-drilling tools. When the pipe deviates from the vertical, a force is exerted on it in the opposite direction.

J. J. Jakosky. U.S.P. 2,153,802, 11.4.39. Appl. 23.11.36. Method and apparatus for continuous exploration of bore holes, consisting of taking electrical measurements using the drill pipe and bit as one electrode in conjunction with another electrode connected to earth in a remote position of well.

L. L. Snyder. U.S.P. 2,153,815, 11.4.39. Appl. 27.7.37. Fluid-operated latching means for inner drill assemblies for use in drilling wells where a circulating fluid is used.

H. C. Block. U.S.P. 2,153,822, 11.4.39. Appl. 19.8.35. Wash-line drive connection for a well-bottom washing.

W. C. Irwin. U.S.P. 2,153,882, 11.4.39. Appl. 14.1.35. Rotary jar.

W. L. Foster. U.S.P. 2,153,883, 11.4.39. Appl. 6.7.36. Oil-well jar.

W. H. McKissick. U.S.P. 2,153,934, 11.4.39. Appl. 15.6.35. Tubing catcher.

A. C. Catland. U.S.P. 2,154,032, 11.4.39. Appl. 10.7.37. Rotary-well bit.

J. C. Hewitt, Jr., and V. E. Kuster. U.S.P. 2,154,162, 11.4.39. Appl. 15.4.35. Means to orient tools in a well.

I. R. Henderson. U.S.P. 2,154,308, 11.4.39. Appl. 16.4.38. A cement sprayer.

A. J. Penick and K. T. Penick. U.S.P. 2,154,408, 11.4.39. Appl. 4.6.35. Combination tubing head and blow-out preventer.

E. G. Gartin. U.S.P. 2,154,445, 18.4.39. Appl. 1.11.34. Rock drill.

L. A. Layne. U.S.P. 2,154,461, 18.4.39. Appl. 21.6.37. Well-gravelling and developing assembly and method.

J. A. Zublin. U.S.P. 2,154,553–2,154,554, 18.4.39. Appl. 29.8.38. Bits for rotary drilling.

C. R. Jenkins. U.S.P. 2,154,621, 18.4.39. Appl. 6.12.35. A device for measuring the length of flexible elements such as ropes, cables, and the like.

A. L. Armentrout. U.S.P. 2,154,654. 18.4.39. Appl. 2.2.38. A fishing tool utilizing a fusible electrode which is to be fused to the lost article in well by an electric current.

R. W. Mueller and G. F. Carle. U.S.P. 2,154,855, 18.4.39. Appl. 2.2.37. Well-casing control head.

R. R. Sanderson. U.S.P. 2,154,960, 18.4.39. Appl. 9.1.36. Percussion bit.

E. B. Hall and A. L. Armentrout. U.S.P. 2,155,129, 18.4.39. Appl. 18.1.38. Drillable well liner made of aluminium, and free of such ingredients as copper, which easily deteriorate in presence of the saline oil-well waters usually encountered.

J. J. Jakosky. U.S.P. 2,155,133, 18.4.39. Appl. 28.10.36. Method and apparatus for electrical logging of wells by measuring the electrical conductivity of formations.

E. B. Hall and A. L. Armentrout. U.S.P. 2,155,369, 18.4.39. Appl. 27.7.36. Well liner built in sections, connected by weak joints; thus sections may be broken and removed.

R. N. Bean. U.S.P. 2,155,380, 25.4.39. Appl. 13.3.37. A packer.

R. N. Bean, H. C. Block, and L. A. Layne. U.S.P. 2,155,381, 25.4.39. Appl. 25.9.37. A bottom assembly for setting strings.

R. N. Bean. U.S.P. 2,155,382, 25.4.39. Appl. 27.9.37. Hydraulic release for well bottoms

H. H. Jones. U.S.P. 2,155,552, 25.4.39. Appl. 5.6.29. Well-hole inclinometer.

G. D. Johnson. U.S.P. 2,155,601, 25.4.39. Appl. 22.8.36. Bailer.

W. R. McClendon and W. D. Owsley. U.S.P. 2,155,609, 25.4.39. Appl. 23.1.37. Multiple stage cementing.

D. Scaramucci. U.S.P. 2,155,620, 25.4.39. Appl. 21.3.38. Measuring line equipment.

C. R. Dale. U.S.P. 2,155,785, 25.4.39. Appl. 25.10.37. Cement dump bailer.

A. J. Penick and K. T. Penick. U.S.P. 2,155,837, 25.4.39. Appl. 2.8.35. Blow-out preventer with bypass for pressure relief.

C. W. Cooper. U.S.P. 2,156,052, 25.4.39. Appl. 19.4.37. A well-logging apparatus using sound waves.

J. E. Terrill. U.S.P. 2,156,207, 25.4.39. Appl. 4.2.38. An apparatus for washing and cementing wells.

T. H. Dunn. U.S.P. 2,156,219, 25.4.39. Appl. 5.6.37. A method of plugging brine-bearing strata chemically by injecting lead nitrate under pressure. Lead chloride is precipitated thus plugging the formation.

T. H. Dunn. U.S.P. 2,156,220, 25.4.39. Appl. 30.6.37. A method of plugging water-bearing formations by introducing under high pressure a solution of magnesium salt followed by a solution of an hydroxide. Magnesium hydroxide is formed in a copious, voluminous, gelatinous precipitate which plugs the formation. A. H. N.

Production.

1153.* Bemis Potential Obtained by Productivity Index. H. F. Simons. *Oil Gas J.*, 2.3.39, **37** (42), 49.—Three instruments may be used in a new method for obtaining productivity index by determining the fluid level in the well. The author describes the principle of the instrument and mode of operation in finding the productivity index. A typical wave-reflection chart from one of the test runs is shown.

If this new method proves successful, it is believed that open-flow physical potentials may be entirely abandoned in the State of Kansas. Productions during the pre-test and test period averaged less than 500 brl./well, whilst a similar potential formerly would have required the production of at least 1116 brl./well. A. H. N.

1154.* Recycling of Gas Following Completion Aids Recovery from Shoe-String Sand Field. H. F. Simons. *Oil Gas J.*, 9.3.39, **37** (43), 44.—An old property was employed as a large-scale laboratory for determining the type of formations and methods most suitable for repressuring, whilst at the same time the increase obtained in production made the project profitable. A detailed description of the equipment and well spacing and all relevant data regarding pressure and time are given. A. H. N.

1155.* Pressure Maintenance Project of Corpus Christi Corporation. N. Williams. *Oil Gas J.*, 16.3.39, **37** (44), 50.—Efficient fluid recovery is facilitated from high-pressure gas-producing horizons by recycling operations carried out by Corpus Christi Corporation in the Stratton field. Conservation of gas is effected by returning stripped gas to the producing formation, thus maintaining reservoir pressure. The extraction of fluid from the gas is done entirely by pressure reduction, cooling, and expansion of the gas. The stripped gas is picked up by compressors which boost the pressure and return the gas to the field. 55,000,000 cu. ft. of gas are handled daily. Details of the cooling, pressure-reducing, and boosting operations are given, together with the properties of the extracted fluid and figures relating to the actual values of pressures and temperatures at various points.

The plant is designed with efficiency as a guiding principle. Energy is conserved by heat exchangers and the correct application of thermodynamical principles.

In the installations are special safety features, which are described; these should prove of interest to readers. A. H. N.

1156.* Condensate Wells—Completion and Recycling Operations. E. V. Foran and P. C. Dixon. *Oil Gas J.*, 23.3.39, **37** (45), 82.—It is pointed out that at high pressures liquids have higher vapour pressures than is ordinarily the case, and that at 3000-4000 lb., and below about 185° temperature, the upper zone (Big Lake field), with its water-white oil, is existent in the formation in the gas phase entirely. Wells which produce these high-pressure gases from which a " water-white oil " is condensed are called " water white," " distillate," or " condensate wells." The last term is the most fitting name.

Retrograde pressure condensation is defined as a process wherein a condensation is produced by pressure reduction at constant temperature, and retrograde pressure vaporization is the reverse of this process. Similarly, retrograde temperature condensation is a process wherein a condensate is produced by temperature increase at constant pressure, and retrograde temperature vaporization is the reverse of this process. The principle and operation of condensation processes are given.

In the well completion it was found that gun perforation did not give good results, due probably to the hardening of the formation and consequent reduction of its permeability just around the shot hole. One type of efficient completion in an unconsolidated formation was to set the casing on top of the producing horizon, drill into and underream the pay, and set a screen with gravel pack.

The mechanics of recycling operation is considered, and some mistakes in pattern development are pointed out. The paper ends with 5 references to recent papers.

A. H. N.

1157.* Oil Development and Production Practices in South-west Texas. C. H. Row and R. H. McLemore. *Oil Gas J.*, 23.3.39, **37** (45), 89.—In the latter part of this extensive paper a summary of drilling completion and producing practices in three zones is given. Steam-driven rotary rigs are generally employed. The usual rig is capable of drilling upwards from 9000 ft. Details of the rigs, water, mud, and operational programmes are given for each zone.

While wire-wrapped screen is still employed in the completion of many wells, the general practice is setting casing on bottom, perforating and producing without any screen or liner. The wells are flowing under a 24-hr.-per-day programme under the smallest choke which will permit the allowable to be obtained over the 24-hr. period. Details of artificial lifting operations are also given.

An interesting item included in the paper is the cost of typical wells. A. H. N.

1158.* Well-Completion Data Obtained in Oil-Field Development. S. F. Bowlby. *Oil Gas J.*, 23.3.39, **37** (45), 98.—A better understanding of the reservoir and its contents, obtained through early detailed observations and proper interpretations, has made it possible to take immediate action in determining the best completion procedure. As a consequence, it is now expected that the improved methods of completion and production will recover a far greater percentage of the oil underground than was formerly estimated, whilst in the exploitation of high-pressure gas distillate zones it is possible to recover and save approximately 100% of all hydrocarbons present.

The data and records necessary for the efficient completion of wells and development of a field are studied by the author under three headings: (*a*) basic completion data, (*b*) actual completion data, and (*c*) performance data. Each of the three items is discussed in detail, and the use of electrical logging is defined both with regard to the advantages accruing from using it and to its limitations, such as its inability to differentiate between gas and oil. Typical well-completion records are given, and it is concluded that usability should be the keynote in assembling data and keeping records. Only data which have a correlative value should be included in the graphic record, whilst the written record should be unstinting with regard to all factual details. Three good reasons are given for the proper recording of completion data: (1) technical—the graphic record is a tool of the engineer and geologist, and should be understandable by all; (2) scientific—the proper recording of actual facts gives the research worker a practical background which will eliminate lost motion in this direction, and (3) legal—the graphic record with the subsurface deductions to be made therefrom is admitted as evidence in conclusion. A. H. N.

1159.* Ryan Salt-Water Disposal in Bemis Pool. P. Reed. *Oil Gas J.*, 30.3.39, **37** (46), 174.—The disposal of some 1877 brl. of saline water which is unsuited for either human or animal consumption is being carried out by pumping it back through a disposal well by a closed system. The dimensions and operation of the system are given, as well as the chemical analysis of the saline water. The well takes the water at a pressure of 235 lb., whilst the pressure between each of the pumping period falls to 20 lb.

The cost of the system is tabulated, an abridged table being given below:

Drilling and equipping of disposal well and pumping station	\$5,242·63
Lead lines (2 items)	820·80
Total	\$6,063·43

Since the system was put into operation a total of 55,650 brl. has been injected (up to March 1st). A. H. N.

1160.* Study Pressure Maintenance at Cotton Valley. G. Weber. *Oil Gas J.*, 6.4.39, **37** (47), 49.—An experimental plant for gasoline extraction and recycling has been recently put into operation, handling 12,000,000 cu. ft. daily at present operating pressures, for the purpose of providing data for a general pressure maintenance plan now under consideration for the field as a whole. The plant is located in the centre of the field structure. The importance of the plan is due to the size and importance of the field. The Bodcaw sand of the lower Marine formation is now proved to be productive of gas and distillate over an estimated area in excess of 10,500 acres, with estimates of recoverable distillate reserves reaching nearly 50,000,000 brl. under present production practices.

A structure contour map of the field, with contours drawn on top of Bodcaw sand, is given, together with present production practice. The development is on an 80-acre spacing pattern. The field structure is anticlinal and is of unusual regularity, and the sand is uniform and continuous. A. H. N.

1161.* Vacuum Applied to Oil Production. H. F. Simons. *Oil Gas J.*, 6.4.39, **37** (47), 59.—The use of vacuum to reduce the pressure on a producing formation has been revived in California. In small producing areas the practice was originally to pull a vacuum on an entire area with a central plant used to obtain a reduction in pressure. Arguments both for and against the advisability of pulling an extremely heavy vacuum on wells are put forward by production men. The chief argument against it is the danger of producing channelling, thereby affecting the gravity of the oil, whilst the main argument in its favour is that production by vacuum is akin to repressuring.

Most of the wells in the Centralia area are pumped by individual units driven either by internal-combustion engines from 5 to 15 h.p. or by small electrical motors ranging from 3 to 5 h.p. Two general plans have been followed: one calls for a separate installation for vacuum; the other utilizes the same engine or motor for pumping wells and producing vacuum. The former method uses a 1-h.p. motor-driving vacuum pump connected to the well-head. In the latter the pumping beam is made to drive a piston that develops a vacuum with each stroke of the pump. Several arrangements of doing this exist, but all are relatively simple.

In California the gas discharged from the vacuum pump is bubbled through the oil tank, and this is sufficient to raise the gravity of the oil and put it into a higher price class. A. H. N.

1162.* Efficiency of Water-Flooding in Bradford, Important Production Problems. H. M. Ryder. *Oil Gas J.*, 13.4.39, **37** (48), 54.—Efficiency is considered here as the production of the maximum quantity of crude per acre at a minimum cost per barrel. The ultimate cost of a flooding operation may be devided into interest, development, and operation, and this total divided by the number of barrels produced over the life of the flood provides the figure per barrel. The ultimate amount of interest paid is controlled by the rate of development, the volume of production, and the time in which it is obtained. The development cost involves the drilling and equipping of wells and construction of a pressure plant and powers. The direct operating cost includes labour, supplies, and fuel.

To produce with maximum efficiency the following must be considered: (1) drilling pattern, (2) well spacing, (3) water pressure, and quality, (4) completion of wells, (5) conservation of gas supplies, (6) selection of machinery, (7) effective control of operations.

The first four items are considered, as they have in common a dependence on sand conditions. All, however, are important.

The five-spot appears to be the most widely used drilling pattern, although Muskat has shown the four-spot or seven-spot to be somewhat more efficient. The author confirms Muskat's findings.

There is a waiting period between water first being pumped in and the desired increase in oil production. The shorter this waiting period the better, and three ways may be used to effect this shortening: (1) heavier shooting, (2) higher pressures, (3) increasing the number of intake wells in a given area. This again, on analysis, shows the seven-spot pattern to be the most efficient.

The inefficiency of too many wells per acre is shown by equating cost of well and

number of barrels of oil producible per acre; yet many operators still use the closer spacing. The time required to deplete an area, using any particular pattern, will vary roughly with the square of the spacing. By changing the pattern and adjusting the pressure this can be compensated for. Hence there is no best spacing for all sands.

The higher the pressure the higher are the capital investment and operational expense, but the smaller the number of wells required; also the higher pressures remove a larger percentage of oil from the sand. The highest pressure, at the surface, that may be used is equal in lb./sq. in. to the number of feet to the top of the sand. Each property must be worked out on its merits, taking permeability of sand into account.

The water quality should be such as not to clog the sand nor corrode the pipe. The area should be flooded regularly and no area "watered out" before the others for maximum efficiency.

The problem of the ever-varying permeability of the sand tending to make the last requirement almost impossible should be studied in detail, and the corrections introduced by appropriate shots using shells of varying diameters and placing spacers in accordance with the exact nature of the sand as found by test in each well.

Typical cases are illustrated in detail in the paper. A. H. N.

1163.* Economics of Gravel-Packing in Completing Oil Wells. W. A. Clark. *Oil Gas J.*, 27.4.39, **37** (50), 46.—The paper is in the nature of a progress report covering the performance of gravel-packed wells in certain areas having the oldest histories of gravel-packing. During 1938 operating costs on individual wells showed a substantial advantage in favour of those wells which were gravel-packed, as compared with conventional wells of similar structural and zonal position. Costs are shown in detail in tabular form.

The average monthly production per well favoured those which were gravel-packed by 41%. The following may account for the greater production :—

(1) The gravel-packed wells may pump for long periods before pulling.

(2) Better pump efficiencies are possible, as the pumps may be inserted deep within the liner in the gravel-packed wells without fear of sanding up, as in the case in conventional wells.

(3) Possibly improved production efficiency from the zone, due to the large-diameter hole in the gravel-packed wells.

(4) In the San Joaquin Valley an additional reason may be that gravel prevents heaving and appears to act in part as a "gas separator." A. H. N.

1164.* Gas Lift in Many West Texas Fields. D. H. Stormont. *Oil Gas J.*, 4.5.39, **37** (51), 56.—Various reasons are leading West Texas operators to adopt gas-lift methods for the recovery of oil. High-pressure gas is led directly from gas producers to inlet wells. The gas-lift problems in West Texas have been resolved by adapting the equipment at hand to conditions existing in each individual case. A review is given of different cases and the action of intermitters is described. A. H. N.

1165.* Multiple Sand Completion Uses Removable Casing. H. F. Simons. *Oil Gas J.*, 11.5.39, **37** (52), 49.—To produce efficiently from two horizons simultaneously through one well, a removable section of casing is employed. This removable section is either dissolved by acid or removed mechanically. In the Louden field it is imperative for effective production to have open holes opposite both producing horizons, whilst the intermediate formations should be properly cased. The lower producing formation is left as an open hole. The upper producer is located accurately and a removable liner is interposed in the steel casing pipe so that it comes exactly against the sand. The whole string is cemented in the usual manner. After 72 hr. the removable section is drilled out in one case; a scraper is then used to form a cement-free sand face ready for shooting. In the second case, from 1000 to 1500 gal. of 15% hydrochloric acid are pumped through tubing. When hydrogen no longer comes out of the well the metal pipe is considered dissolved. Excess acid is used, and this is pumped out. After shooting and testing the upper sand, the cement is drilled out of the lower depths and the lower sand is shot and cleaned for production. In another method the lower sand is completed first and the upper sand put on production last. A. H. N.

1166.* Pumping Problems in the Sand Areas of Winkler, Ward Counties, Texas. J. T. Reeves. *Oil Gas J.*, 18.5.39, **38** (1), 76.—The specific problems of this field are discussed with reference to an average well. The chief troubles of general interest are due to floating sands and to the large volumes of gas accompanying the oil, producing general gas-lock troubles.

Gas anchors are discussed. The most usual form is a closed-end type, with or without a dumping valve; but this, in the opinion of the author, is not as effective as the open-end type, which he describes in detail.

To avoid sand troubles in the pumps, it is recommended that the fluid be as little agitated as possible, and that a metal-to-metal arrangement of piston and liner be arranged with a clearance of only one-thousandth of an inch. A. H. N.

1167.* Time Switches Factor in Reducing Lifting Costs. W. C. Lane. *Oil Wkly*, 15.5.39, **93** (10), 35.—The advantages of incorporating a time-switch in order to operate automatically and intermittently electrically controlled pumping wells are discussed. A diagram of connection is given. A. H. N.

1168.* Problems of Pumping in Repressured Areas. J. W. Cushing. *Oil Wkly*, 29.5.39, **93** (12), 18.—Repressuring introduces problems in oil pumping which are both new and difficult, varying with such factors as the producing formation, type of oil produced, repressuring medium, pumping equipment, pumpers and combinations of two or more of these. For instance, a great deal depends on the pumpers in watching and reporting wells which are unduly influenced by injected gas or air, or if the gas/oil ratio appears to increase excessively as compared with other wells.

Vapour lock may introduce difficulties in pumping. When gas is injected into the sand, the gas which is not absorbed by the oil moves along with the oil to a producing well and causes a vapour lock in the working barrel.

The use of air creates more difficulties than gas, as it has a corrosive action on subsurface pumping equipment. Reducing the air flow from the well to a minimum should help to combat corrosion.

Amongst the problems and difficulties discussed is the warning regarding the use of the gas from the sand as a fuel when air is injected. An explosive mixture may be obtained, with disastrous results. A fuel supply obtained from a different source than the oil sand should be sought. A. H. N.

1169.* Production Methods in the Rodessa Field. T. H. Gibbs. *Petrol. Engr*, May, 1939, **10** (8), 37.—The paper deals with problems encountered in successive stages of production from natural flow onward. In the natural-flow period proration, gas/oil ratios and water form the chief factors to be studied. In the last stages of natural flow the wells are "rocked" or "kicked-off" where a supply of high-pressure gas is available. Where permeability is low, "stopcocking" is found effective.

Artificial production of oil is generally accomplished by gas-lift. Starting valves are installed so that starting pressures need not be greater than operating pressures. Valves for inducing intermittent flow work on the same principles and are widely used. Under optimum operation, flow-valve operation will result in greatly reduced input gas/oil ratio. Leakage through valves would cause large gas losses, intervalve interference, and paraffin deposition.

Intermittent flow chambers, which are described, are used in the east side of the field. It is best to submerge the unit just below the fluid level in the well. Similarly plunger-lift which is also practised depends on submergence. Therefore, the productivity and operating-pressure decline of any one size of plunger will parallel the decline in reservoir pressure. A. H. N.

1170.* Comparison of Rotary, Beam, and Pneumatic Counterbalances. Pt. I. K. N. Mills. *Petrol. Engr*, May, 1939, **10** (8), 42.—The fundamental purpose of any counterbalance is to decrease the peak load imposed on the driving mechanism, and hence its effectiveness in accomplishing this purpose is the first measure of its efficiency; but it must achieve this aim with equal effectiveness at all practical operating speeds.

Detailed graphic study of the balancing effects of the three types are made, and typical polished-rod dynamometer card and torque curves for counter-clockwise

rotations are given. In the case of rotary and pneumatic counterbalancing, the speed of the crank has no effect on the efficiency of the counterbalancing. In the case of beam balancing, however, the effective weight of a beam counterbalance is a function of the vertical acceleration, and consequently of the speed of the crank. Hence an efficient counterbalance at one speed may induce stresses at another speed sufficient to break the beam. By a study of the bending moment diagrams of beams at both low and high speeds with beam counterbalancing, it is shown that such effects may be obviated by so placing the weights as to have their centre of gravity coincident with the centre of the pitman bearing. A. H. N.

1171.* Comparison of Rotary, Beam, and Pneumatic Counterbalances. Pt. II. K. N. Mills. *Petrol. Engr*, June 1939, **10** (9), 144.—When the rotary counterbalance is used, the full load of the well is taken by the pitman, whilst in the other two cases the counterbalance forces oppose the well load and relieve the pitman—these forces becoming larger with increasing speed. This property cannot, however, be utilized, as it may cause bearing troubles. The chief disadvantage of the rotary counterbalance is that it imposes greater loads on the crankshaft, this increase in loading depending on the pumping speed and the general design of crank. As forces are transmitted to the reducer foundation it creates problems in designing the foundations which have to be realized and solved. It has also been shown that, with rotary counterbalance, the natural period of torsional vibration of a pumping reducer may occur in the operating speed range of the prime movers in general use. Prolonged operation at the critical speed may cause failure.

A disadvantage of beam and pneumatic counterbalancing is realized practically, although it cannot be seen from an analytical study of the problem, and that is that at two points of zero torque the gears are unloaded and have a tendency to clatter on engine-driven wells, and when the load is put on again, considerable impact is developed. Sufficient rotating inertia on the crankshaft eliminates this trouble.

The chief objection to a properly designed beam balance is that it is difficult to adjust the amount of counterbalance effect created by it. When a combination of beam and a small adjustable rotary counterbalance system is used, the maximum counterbalance efficiency may be obtained at the lowest initial investment. A. H. N.

1172.* Production Measurement and Regulation of High-pressure Gas Wells. J. J. Carter and C. E. Webber. *Refiner*, 1939, **18** (5), 206.—High-pressure dry gas can be measured with sufficient accuracy by means of the usual orifice meter, provided the Z factor for pressure correction is known. The Bean method or the authors' modification of the same is preferred for the evaluation of this factor. Graphs of this deviation factor for methane and a natural gas are given. It is claimed that reasonable accuracy is obtained in measuring dry gas by putting a stroke recorder on the compressor to count the strokes on the cylinders. This method is particularly useful in cases of pulsating flow.

In the measurement of high-pressure wet gas many problems may occur—*e.g.*, retrograde condensation, hydrate formation, etc. It is considered advisable to instal chokes downstream from the orifice meters to obtain reliable measurements. Additional certitude requires a hydrocarbon analysis and a density on the gas to assess the Z and gravity correction factors. G. R. N.

1173.* Acidization of Oil Wells. A. A. Trofimuk, T. A. Shikanova, and N. M. Karpenko. *Neft. Khoz.*, April–May 1939, **20** (4–5), 33–39.—Hydrochloric acid treatment is applied when the crude is contained in limestone or dolomite. The hydrochloric acid dissolves these minerals, thereby facilitating the access of oil to the well.

Since the introduction of hydrochloric acid treatment in the Kirov field an additional yield of approximately 40,000 tons of crude oil has been obtained. Certain defects, mainly of an organizing nature, are indicated.

A general instruction for hydrochloric acid treatment of oil wells is given, including: (1) necessary acid concentration, quantity of solution, and time interval of reaction; (2) necessary chemicals, their properties, and method of preparing solutions; (3) safety measures in hydrochloric acid application; (4) necessary equipment; (5) preparation of the oil well and operations during treatment; (6) operations after treatment; (7) organization of work; (8) method of estimating efficiency of treatment. L. R.

1174.* Production Patents. W. M. Mansfield. U.S.P. 2,152,701, 4.4.39. Appl. 16.11.36. Counterbalance for oil-pumping apparatus.

W. M. Mansfield. U.S.P. 2,152,702, 4.4.39. Appl. 9.8.38. A pivoted counterbalance for oil pumping.

G. T. Humphrey. U.S.P. 2,152,762, 4.4.39. Appl. 26.4.37. A straight-lift oil well pumping apparatus.

C. R. Wagner and R. H. Carr. U.S.P. 2,152,779, 4.4.39. Appl. 6.7.37. An apparatus and method of water injection for water-drive purposes without clogging the formation. The water is always maintained under an inert gas so that precipitation due to oxidation is avoided.

H. Dripps. U.S.P. 2,152,794, 4.4.39. Appl. 8.2.38. Bottom-hole sample taker.

C. H. Bills. U.S.P. 2,152,863, 4.4.38. Appl. 7.12.37. Sand, water and oil segregator tank.

W. L. Church. U.S.P. 2,152,873, 4.4.39. Appl. 10.6.37. A well pump.

A. R. Maier. U.S.P. 2,153,094, 4.4.39. Appl. 21.12.35. An oil well pumping apparatus.

M. De Groote. U.S.P. 2,153,744–46, 11.4.39. Appl. 28.2.38. Processes for resolving petroleum emulsions of the water-in-oil type.

B. H. Stevens. U.S.P. 2,153,816, 11.4.39. Appl. 30.11.37. Sucker rod jerk absorber.

B. E. Parrish. U.S.P. 2,153,843, 11.4.39. Appl. 22.7.35. Well swab.

C. D. Hathcock. U.S.P. 2,154,331, 11.4.39. Appl. 9.2.38. A well pump.

M. De Groote and C. M. Blair, Jr. U.S.P. 2,154,422–23, 18.4.39. Appl. 12.8.38. Composition of matter and process for resolving petroleum emulsions.

H. C. Otis. U.S.P. 2,154,768, 18.4.39. Appl. 14.2.35. Means for flowing oil wells with independent oil and gas valves.

I. J. McCullough. U.S.P. 2,154,859, 18.4.39. Appl. 19.5.36. Gun perforator.

I. J. McCullough. U.S.P. 2,155,322, 18.4.39. Appl. 8.3.37. Gun perforator.

E. O. Bennett. U.S.P. 2,155,635, 25.4.39. Appl. 2.5.38. Bottom-hole pressure gauge.

L. A. Layne and L. C. Mundt. U.S.P. 2,155,718, 25.4.39. Appl. 19.11.35. Washpipe anchor.

L. A. Layne. U.S.P. 2,155,635, 25.4.39. Appl. 5.5.36, and U.S.P. 2,155,636, 25.4.39. Appl. 9.5.36. Well strainer.

C. van Westrum. U.S.P. 2,155,744, 25.4.39. Appl. 23.6.36. Well strainer.

J. T. Phipps. U.S.P. 2,156,228, 25.4.39. Appl. 6.10.37. Gun perforator.

A. H. N.

Gas.

1175.* Control Practices in Processing Natural Gas. H. N. Wade. *Refiner*, 1939, **18** (6), 248.—The author gives three principles: (1) control only essential functions, (2) use the fewest devices which will secure the desired control, and (3) match the refinement of the control to the accuracy required by the process. Using these principles as a basis, the control systems are built up for a diethylene-glycol gas-dehydration unit and a distillate extraction and gas-pressure-maintenance plant.

G. R. N

1176.* Evolution of Gases in Oil Storage Tanks. A. C. Thaysen. *J. Inst. Petrol.*, 1939, **25**, 411–415.—An account of several experiments on the activity of micro-organisms, which occur in the bottom layers of oil-storage tanks. G. R. N.

1177.* Protection from Dangerous Gases in Oil Tanks. A. W. Cox. *J. Inst. Petrol.*, 1939, **25**, 416–425.—This subject is discussed under dangers of empty tanks, explosive and inflammable limits, Home Office regulations, cleaning and vapour-freeing tanks, treatment for various products, testing for inflammable vapour, taking of samples, electric-testing methods, flame-testing methods, potential sources of vapour, removal of water and residues, precautions in vapour-testing work. G. R. N.

1178.* Flue-gas Protection for Ships' Tanks. O. W. Johnson. *J. Inst. Petrol.*, 1939, **25**, 426–434.—The manner of formation of explosive mixtures in ships' tanks is reviewed, and it is shown that most of the danger from explosion can be avoided by excluding air from the tanks, supplying in its stead an oxygen lean flue gas, to take the place of the discharged oil. The equipment, making up a complete flue-gas system and its operation are briefly described. G. R. N.

1179.* Automatic Recorder for Inflammable Gases. H. Lloyd. *J. Inst. Petrol.*, 1939, **25**, 435–439.—The principles and design of instrument used by the Safety in Mines Research Board in the application of preventive measures against risks of fire and explosion in coal mines are described. G. R. N.

1180.* Portable Combustible Gas Indicators in the Oil Industry. O. W. Johnson. *J. Inst. Petrol.*, 1939, **25**, 440–448.—The development of the J.-W. combustible gas indicator is briefly described, and the use of such instruments as this to control tank cleaning is fully discussed. G. R. N.

1181.* Vapour Detectors in the Petroleum Industry. P. Docksey. *J. Inst. Petrol.*, 1939, **25**, 449–455.—Detectors for gas/air mixtures may be grouped according to basic principles—*i.e.*, chemical diffusion, volume changes on combustion, heat of combustion. The suitability of these principles are discussed, and it is shown that detectors based on the last principle meet the requirements well. G. R. N.

1182.* "Riken" Explosive Gas Indicator. J. S. Jackson. *J. Inst. Petrol.*, 1939, **25**, 456–458.—This instrument, which is based on the refractometric analyses of methane/air mixtures, incorporates the Doi refractometer. G. R. N.

1183.* Inflammation of Hydrocarbon–Air Mixtures. D. T. A. Townend and M. Maccormac. *J. Inst. Petrol.*, 1939, **25**, 459–486.—A comprehensive paper on inflammability intended to make clear its recent developments and to direct attention particularly to experimental work on "cool" flames. G. R. N.

1184.* Inflammable Vapour Explosions. J. S. G. Shotwell. *Chem. & Ind.*, 1939, **58**, 778–783.—Explosions of inflammable vapours or gases in the underground ducts and cavities of thickly populated localities form a problem that has been causing the various public authorities responsible increasing trouble. Practically all such explosions are due either to the escape of town gas into underground systems, or of inflammable liquids, usually gasoline, into sewers. Several typical examples in Great Britain, U.S.A., and Canada are instanced.

Ottawa (Canada) has investigated the problem over the last few years. In 1934, of 273 leaks of vapour into the city's underground system, 139 were due to petroleum and 134 to gas. In 1938, of 253 leaks, 89 were due to petroleum and 142 to gas.

It is interesting to note that a cupful of gasoline will give off enough inflammable vapour to create an explosive mixture through 100 yd. of the average lateral sewer in a residential district.

Experience gained by the Ottawa authorities has led them to develop a precautionary system. This is based upon a Complaints Bureau, to which the public are encouraged to report unusual odours, and upon a systematic inspection of all manholes, sewers, etc., by trained investigators using inflammable vapour detectors.

It is noted that in 1938, of 42,872 complaints, 26,180 were received through the Complaints Bureau and 16,692 through the gas company. Typical cases of explosions that have been averted by the Ottawa system are instanced. T. C. G. T.

Cracking.

1185.* Catalytic Reforming in Small Units Gives 8 to 23 Octane Number Rise. A. L. Foster. *Nat. Petrol. News*, 20.9.39, **31** (38), R.394–R.403.—The article is a critical examination from the economic standpoint of the several cracking processes, and the author concludes that the catalytic cracking process is unsuitable for operation on a small scale. On the other hand, the catalytic reforming of low-grade gasoline is feasible on a very small scale, and is capable of producing 95-octane-number aviation blending stock. The preparation of neohexane-2 : 2-dimethylbutane is also mentioned. This new product of catalysis is now available, in limited quantities, commercially. With an octane rating of 95/96 and a Reid v.p. of 9·5 lb., it possesses satisfactory volatility, and can be blended with *iso*-octane or *iso*pentane to give it a typical distillation curve. H. G.

1186.* The Houdry Process. M. G. Van Voorhis. *Nat. Petrol. News*, 23.8.39, **31** (34), R.346–R.368.—The article comprises the design and operation of a new 15,000-barrel continuous catalytic cracking plant for the production, on a once-through basis, of No. 2 fuel oil and moderate yields of high-octane gasoline. The gasoline is usually blended into premium motor fuel, but at times is used in the production of aviation fuel. Other plants of the same type produce higher gasoline yields. Operating on East Texas crude with a straight-run gasoline yield of 38%, the total gasoline yield is increased to 63% by this process. Significant features of the plant are its compactness—it occupies an area 389 × 140 ft.—the small amount of high alloy steel used, the use of molten salt instead of water for the controlling of catalyst temperatures, high proportion of liquid recovery—96%, not including excess butane, and the consequent low tar production, and low labour costs—only eight men per shift are needed. H. G.

1187.* Catalytic Refining in Vapour Phase of Liquid Phase Cracked Gasolines on a Solid Zinc Chloride Catalyst. M. M. Guerasimov, V. E. Glushnev, S. N. Solodov, A. N. Tsiba, and M. N. Sharonov. *Neft. Khoz.*, June 1939, **20** (6), 43–45.—On basis of laboratory tests it is concluded that : (1) vapour phase refining of liquid phase cracked distillates, by passing over solid zinc chloride on a coke carrier, yields a high-grade engine fuel with improved lead susceptibility ; (2) the catalytic method of refining increases the yield of commercial product and eliminates waste by-products, such as acid-sludge of sulphuric acid treatment. The polymers obtained are useful raw materials for various branches of industry. L. R.

1188.* Gunite Liners for Pressure Vessels. E. S. Dixon. *Refiner*, 1939, **18** (6), 225.—Gunite—*i.e.*, concrete applied with a cement gun—is particularly adapted for liners installed in the vapour space of soaking-chambers where temperatures of 850–900° F. and pressures of 350–400 lb. are operative, when only one year's wear is required. The wall surface of the vessel must be clean, and this is accomplished by scaling off old deposits and then sand blasting at 80–100 lb. air pressure. Reinforcement for the gunite takes the form of 3 × 3 electric welded 10-gauge mesh supported on vertical rods welded to the walls of the vessel. The gunite is applied by a machine which takes a dry mixture of 1 part Portland cement and 2½ parts of sand. On leaving the nozzle, water is added, and the wet mix is built up to a thickness of 1 to 1½ in. on the wall. Gunite liners are cured after the initial 24 hr. setting by 3 days' exposure to a water fog ; they are then air dried for the next 24 hr. Two similar periods of steam curing and air drying complete the hardening cycle. Overall costs vary from 0·86 to 1·11 dollars per sq. ft. of surface. G. R. N.

1189.* Recent Developments and Operation of Instruments for Controlling Cracking Equipment. R. L. Rude and C. Barnes. *Refiner*, 1939, **18** (7), 255.—The method for the continuous determination of density *in situ* of a flowing fluid has been applied to

the construction of instruments for the control of cracking equipment. The limitations of temperature control when applied to a system in which vaporization and chemical change may be occurring are recognized. A suitable use of controls actuated by density variations not only gives a sensitive regulation of the heat supplied to a cracking furnace, but also enables the time-element in cracking to be utilized for control from yield per pass. The general arrangement of instruments and controls connected with a modern heater is described, and the advantages from the point of view of flexibility, sensitivity, and stability of operation are disclosed. In particular it has been observed that fluctuations in temperature lag from 1 to 2 min. behind the associated fluctuations in density. The ability of the control system to repress the effects of major disturbances in operating conditions is illustrated by charts obtained with the instruments. Controls responsive to density *in situ* provide additional safety factors in meeting operating emergencies. G. R. N.

Polymerization.

1190.* Synthetic Oils from Unsaturated Hydrocarbons. E. Neyman-Pilatowa. *Nat. Petrol. News*, 23.8.39, **31** (34), R.370–R.371.—Using aluminium chloride as the catalyst, olefins have been polymerized to produce bodies with lubricating properties. Three sets of experiments are described in which (*a*) pure *iso*amylene obtained by the dehydration of amyl alcohol, (*b*) technical *iso*amylene, and (*c*) cracked gasoline from a Cross cracking unit were used. The pure hydrocarbon produced the highest yield of the best-quality product. In this case a 50% yield of oil with the following properties was obtained: $d(20/4)$ 0·8513, aniline point 147° C., molecular weight 620, content of cyclic bodies 6%, viscosity 251° E. at 50° C, 10·6° E. at 100° C., polarity 1·91. Although under the conditions of the British Air Ministry Oxidation Test no asphaltic bodies were produced, the oil suffered a big increase in viscosity owing to the evaporation of lower-boiling fractions. H. G.

Refining and Refinery Plant.

1191.* Lighting of Refineries and Refinery Equipment. L. E. Priester. *Refiner*, 1939, **18** (5), 204.—A general article which discusses what is considered good practice from the standpoint of efficient illumination in refineries, due precaution being taken to safeguard persons from electrical hazards and to protect buildings and equipment from possible fire or explosion hazards. G. R. N.

1192.* Petroleum Refining and Progress in Metallurgy. E. E. Thum. *Refiner*, 1939, **18** (6), 213.—A comprehensive and authoritative account of the development of alloys of steel and other metals and their application in the petroleum industry with reference to the cost of alloys, austenitic alloy, stress corrosion, and creep strength of low-alloy steels. G. R. N.

1193.* Automatic Control of Solvent Treating Plants. J. F. Thornton and T. T. Whipple. *Refiner*, 1939, **18** (6), 238.—Taking as examples a furfural unit and a M.E.K.-benzol plant the authors take each stage of these processes and describe the automatic control instruments which record as required temperature, pressure, flow, and liquid level, and which have proved the most satisfactory in service. G. R. N.

1194.* Practical Use of Engineering Factors. H. F. Moore. *Refiner*, 1939, **18** (6), 245.—The underlying principles governing automatic control of continuous processes have been developed mainly in the last ten years. Together with their evolution there has been a parallel development of control equipment, the operation and characteristics of which have been based on the successively established principles. It is probable that the next major step in control technology is in the field of proper application. Sound development along this line must depend on a departure from present crude methods of analysing control problems, which are largely empirical. Possible starting points of quantitative methods for applying automatic controls to refinery equipment are given, and two elementary examples are worked out to illustrate the author's line of thought. G. R. N.

1195.* Stratcold Treating Process. Anon. *Refiner*, 1939, **18** (7), 267.—A three-stage unit of this process has been installed at the Los Angeles refinery of the Texas Co. to control the sulphur content of the cracked gasoline by economical methods. The new unit comprises the acid-contacting and separating stages only. A feature of the treating system is the weak acid pre-treating stage, in which nitrogen compounds are removed from the cracked gasoline. The refrigerating system utilizes ammonia, and three-spray type chillers cool the oil before it passes into the contactors. The plant will treat the cracked gasoline with 14 lb./brl. of 98% black sulphuric acid. The investment cost was 50 dollars per brl. of rated capacity (5000 brl./calendar day). It is stated that the refinery operation has been made much more flexible, because of the resulting ability to reduce the sulphur in the finished cracked gasoline to any required specification with a reasonably low acid dosage and a materially increased yield of marketable product of a desired specification at a very reduced and low operating cost.
G. R. N.

1196.* Application of Centrifugal Pumps to Refinery Service. K. P. Hurley. *Refiner*, 1939, **18** (7), 278.—The author briefly states the underlying fundamentals of centrifugal pump design and gives some of their most important applications. The pump designs discussed have been relatively few, and only a few specific services have been mentioned; but all the pumps have the basic features required for successful refinery pumps, and, therefore, with slight, if any, changes can be used for the wide variety of services in the modern refinery, whether it be a combination cracking plant, a polymerization unit, a solvent plant—for handling cold oil, hot oil, light refluxes such as propane, or solvents such as cresol, furfural, etc. Several characteristic graphs are given.
G. R. N.

1197.* Influence of Silicon and Aluminium on the Corrosion Resistance of Steels. C. L. Clark and C. H. McCollam. *Refiner*, 1939, **18** (7), 287.—The resistance of refinery steels to oxidation by hot combustion gases and to corrosion by hot petroleum products is called surface stability. High-temperature strength indicates what stresses a steel can safely carry; surface stability dictates how long it can carry them. Improved surface stability is obtained by suitable additions of silicon plus aluminium to chromium molybdenum steels as demonstrated by results of various tests and by refinery tube inspections under actual operating conditions. This has resulted in new steel types, which permit more economical application of intermediate alloy steels in refinery-tube service.
G. R. N.

1198.* Balloon System Prevents Vapour Losses. J. C. Albright. *Refiner*, 1939, **18** (7), 291.—Eight 80,000-brl. tanks are used to store volatile products in a tank farm adjacent to the Shell refinery at Dominguiz, California. A Wiggins balloon system is connected to these tanks to handle the variable volumes of vapours produced through product transfers and changes in atmospheric conditions.
G. R. N.

1199.* Corrosion of Plant by Gases. A. Foulon. *Oel u. Kohle*, 1939, **15**, 459–460.—In the synthetic ammonia processes corrosion is caused by high-pressure hydrogen diffusing into the steel, with the reduction of the carbon present to CH_4, etc., causing blistering. This is overcome by using low carbon steels, with 3–7% Cr and in addition Mo and W. Still greater stability is obtained by including metals with great affinity for carbon (Ti, Va, Ta, Nb). Cu is especially liable to corrosion in the presence of hydrogen as a result of its low affinity for oxygen; on the other hand, oxygen combined with Mn, Al, Mg, or Si will not react with molecular hydrogen, and these metals do not suffer attack in the presence of hydrogen.

For fuel plants a steel is required stable to H_2S and SO_2. Ordinary carbon steels are attacked by dry H_2S below 400° C.; 18/8 Cr–Ni steels at about 500–600° C. The action of SO_2 is to form protective oxidic films, so that ordinary carbon steels are not strongly attacked below 500° C., nor 18/8 Cr–Ni steels below 800° C. These figures relate to surface corrosion, and not to the inter-crystalline corrosion to which Ni steels are subject. Since, in practice, H_2, CO, CO_2, and water vapour are present normally besides the sulphur gases, the high alloy steels are preferred.

For cracking operations, 4–6% Cr–Ni steels are generally used; for apparatus especially resistant to corrosion, the steel is even more highly alloyed. For distillation

and refining, medium alloy steels are satisfactory, whilst where corrosion is very liable (*e.g.*, in the water gas producer of the Fischer Tropsch synthesis, or in the reaction chamber of the formaldehyde synthesis), Cr–Ni steels are used. T. T. D.

1200.* Hydrogen Sulphide Removed by Tri-potassium Phosphate. H. N. LaCroix and L. J. Coulthurst. *Nat. Petrol. News*, 9.8.39, **31** (32), R.326–R.332.—H_2S is removed from gases or liquids by washing with a solution of K_3PO_4. $H_2S + K_3PO_4 \rightleftharpoons KHS + K_2HPO_4$. The direction of the reaction is controlled by the operating temperature. The process can be applied at temperatures up to 200° F. The velocity of the reaction depends on the ratio of KHS to K_2HPO_4. Regeneration of the spent solution is easily accomplished by boiling. Where the process is worked on a sufficiently large scale H_2S is recovered as elemental sulphur or as sulphuric acid. H. G.

1201.* Filter-Clay Treatment of Cracked Gasoline in the Vapour Phase. P. T. Sverbil and A. M. Ravikovich. *Neft. Khoz.*, 1939, **20** (3), 41–46.—The treatment of cracked gasoline in the vapour phase with filter earth included in the technological process of two-furnace cracking has a great advantage over the sulphuric-acid treatment. The inevitable losses of sulphuric-acid treatment and re-running of the cracked distillate are eliminated by refining in the vapour phase. Consequently, the yields of commercial cracked gasoline—when operating with a flash tower and returning the polymers into the cracking system—increase up to 34–35% of the charging stock.

Zikeyev filter earth gives fully satisfactory results, even in prolonged use up to 50 days. The consumption amounts to 0·3–0·4% of the finished commercial gasoline.

The gasolines treated with Zikeyev clay in the vapour phase pass the copper-strip test when washed in two stages with 2–2·5 vol. of water. They possess an improved induction period and a somewhat higher stability against gum formation during storage. Induction periods (" Ziatim " method) of gasolines treated with Zikeyev clay in the vapour phase are usually in excess of 240 min.

With the addition of 0·013% α-naphthol, or 0·065% of the wood-tar fraction distilling between 260° and 290° C., a " Ziatim " induction period of 460–565 min. is obtained—*i.e.*, 1·7–2·2 times more than without inhibitors.

In view of its advantages, the introduction of this method of treatment in all cracking plants of the U.S.S.R. is recommended. L. R.

1202.* Selection of Natural Filter Earths for Percolation Filtration. A. D. Drujinina, Babenkov, M. S. Perelmiter, and Shneyerova. *Neft. Khoz.*, March 1939, **20** (3), 46–50.—The action of (1) Volkov-Parshin, (2) Zaimkin, (3) Novo-Simbirsk, and (4) Zikeyev clays, and of (5) American floridine have been examined. At present in the U.S.S.R. for percolation treatment only (5) is used. It has, however, been proved experimentally that it is possible to use Russian clays for the final treatment of concentrate of Ssurakhany ordinary crude which has undergone only a preliminary nitrobenzene treatment and acetone–benzene dewaxing.

The relative properties of the clays have been ascertained as follows :

(1) Volkov clay gives maximum yield of finished oil—*i.e.*, 199% of the clay weight introduced. Owing to its very poor compressive strength, it is, however, unsuitable for percolation filtration. For contact filtering it is the best material available.

(2) Zaimkin earth is equally effective, but screening losses are still high.

(3) Novosimbirsk clay has a low specific weight, good bleaching capacity, small screening losses, and comparatively high compressive strength. Among the clays examined this is the most suitable for percolation treatment, and moreover large resources are available.

(4) Zikeyev clay has average qualities, high specific weight, rapid fall of bleaching capacity, but a comparatively high compressive strength. Its main advantage is the availability in unlimited quantities. L. R.

1203.* Relative Volatility of Petroleum Fractions. R. E. Johnstone. *J. Inst. Petrol.*, 1939, **25**, 558–560.—An empirical expression is derived equating the relative volatility of pure hydrocarbons or narrow cut petroleum fractions, the absolute temperature, and the atmospheric boiling points of the components. G. R. N.

1204.* Natural Gasoline and Poly Plant Chart. W. L. Nelson. *Oil Gas J.*, 22.6.39, **38** (6), 63.—The mathematical computations required in the design of natural gasoline and refinery equipment involve determinations of the compositions of the gas and liquid existing under equilibrium conditions, *e.g.*, in oil-well separators, condensation in gas compressors, temperatures in gasoline or poly stabilizer, gas separator temperatures, fractionating towers, condensers or distillate well separators. A chart has been prepared based on the usual general formulæ showing the distribution of any component between liquid and vapour when at equilibrium. The bases and method of use of the chart are explained with a typical example of the amount vaporized of a feed stock to a poly plant fractionator at 380° F. and 400 lb. per sq. in. abs. pressure.

C. L. G.

1205.* Cone in New Type De Florez Furnace Improves Heat Distribution. G. C. Leslie. *Nat. Petrol. News*, 12.7.39, **31** (28), R.294–R.296.—The furnaces described, said to be the largest of their type ever built, are of the usual vertical, cylindrical, down-draught type, the tubes being symmetrically spaced around the inner wall. A recent refinement is the incorporation of an upright brick cone in the bottom of the furnace for the improvement of heat distribution. These furnaces are stated to represent the nearest approach to the ideal yet achieved.

H. G.

1206.* Water-Tower Performance Predicted by Computation. R. Nance. *Nat. Petrol. News*, 26.7.39, **31** (30), R.316–R.318.—In discussing the economics of tower design and the relative merits of towers, spray ponds, cooling ponds, etc., the following empirical formula is used: $L = \frac{QDW}{CA}$ where L = length of the tower, Q = the quantity, in g.p.m., of water circulated, D = a design factor specific to the particular tower, W = a wind-velocity factor, C = water concentration in g.p.m./sq. ft., A = horizontally projected deck area, in sq. ft. corresponding to unit tower length. This method has been derived from the Ferrel Psychrometric equation for the determination of the total cooling head in terms of water and wet-bulb temperatures and vapour pressures at these temperatures.

H. G.

Chemistry and Physics of Petroleum.

1207. Catalytic Oxidations. II. Oxidations in the *cyclo*Paraffin Series. N. A. Milas and W. L. Walsh. *J. Amer. chem. Soc.*, 1939, **61**, 633–635.—Catalytic oxidation of *cyclo*hexane and *cyclo*pentane and some of their derivatives and adipic acid using vanadium pentoxide resulted in maleic acid as the chief solid product. Alternative views as to the course of the reaction from *cyclo*hexane to maleic acid are put forward by the authors: (1) via benzene and quinone, (2) via *cyclo*hexene, adipic acid, and *cyclo*pentanone, (3) possibly *cyclo*hexane rearranges to methyl*cyclo*pentane and the latter oxidizes to maleic acid.

R. D. S.

1208. Reactions of Paraffins with Hexahydroaromatic Hydrocarbons in the Presence of Aluminium Halides. H. Pines, A. V. Grosse, and V. N. Ipatieff. *J. Amer. chem. Soc.*, 1939, **61**, 640–643.—The authors have found that hexahydroaromatic hydrocarbons react with paraffins in the presence of aluminium bromide or chloride in a manner analogous to the destructive alkylation of aromatic hydrocarbons by paraffins in the presence of aluminium or zirconium chloride or phosphoric acid. Although 2 : 2 : 3- and 2 : 2 : 4-trimethylpentane and 3 : 4-dimethylhexane readily bring about the destructive alkylation of the naphthenes, *iso*butane being formed whatever the alkylating agent used, *n*-octane and 2 : 2 : 3-trimethylbutane do not destructively alkylate *cyclo*hexane under similar conditions. The product of alkylation of *cyclo*hexane was found to be a mixture of the different polymethyl- or methylethyl*cyclo*hexanes. Side reactions were noted to occur, such as hydrogenation and isomerization into *iso*butane of the butene formed from the scission of 2 : 2 : 3-trimethylbutane when reacting with *cyclo*hexane: the latter acts as a donor and the olefins as acceptors of hydrogen.

R. D. S.

1209. Condensation of Propene and *Iso*butene with Benzene in the Presence of Anhydrous Ferric Chloride. W. M. Potts and L. L. Carpenter. *J. Amer. chem. Soc.*, 1939, **61**, 663–664.—Condensation of propene and *iso*butene with benzene occurred at room temperature with anhydrous ferric chloride as the catalyst, but at higher temperatures the yield was not so great. Ferric chloride produced a greater yield of alkylated benzenes, but less polymerization than aluminium chloride. R. D. S.

1210. Identification of Alkylphenyl Sulphides, Sulphoxides, and Sulphones. V. N. Ipatieff and B. S. Friedman. *J. Amer. chem. Soc.*, 1939, **61**, 684–689.—Alkylphenyl sulphides and sulphones were readily identified by means of solid derivatives prepared by the following methods: (1) co-ordination of the sulphide with palladous chloride; (2) oxidation of the sulphide to the sulphone; (3) nitration of the sulphone to form *m*-nitrophenyl alkyl sulphone; (4) reduction of the latter to the aminosulphone; (5) acylation of the aminosulphone with *m*-bromobenzoyl bromide or *p*-bromobenzoyl chloride. The alkylphenyl sulphoxides were also identified by the reduction to sulphides or by oxidation to sulphones and then characterized by the above procedures. Aroylation of the aminosulphones in the presence of pyridine was found to be unreliable, but in the presence of alkali was more successful. It was found that, in the same conditions, *p*-bromobenzoyl chloride gave only the monoacyl derivative, whereas *m*-bromobenzoyl bromide gave only the diacyl derivative.

From the palladous chloride derivative it was found possible to detect and isolate small amounts of *tert.*-butyl or *tert.*-amylphenyl sulphides in mixtures of each with its isomers. *tert.*-Butyl and *tert.*-amyl sulphones differ from their isomers in that they decompose when they are nitrated at 100°. The authors describe a method by which nitration was made possible. 3-Bromo-4′-methylbenzophenone was prepared by refluxing a toluene solution of *m*-bromobenzoic acid over phosphorus pentoxide.

R. D. S.

1211. Raman Spectra of the Hexanes and Heptanes. F. J. Rosenbaum, A. V. Grosse, and H. F. Jacobsen. *J. Amer. chem. Soc.*, 1939, **61**, 689–692.—In this paper are presented the Raman spectra of all the five possible hexane and the nine possible heptane isomers. R. D. S.

1212. Refraction Data on Liquid C_3-Hydrocarbons. A. V. Grosse and C. B. Linn. *J. Amer. chem. Soc.*, 1939, **61**, 751–752.—Measurements have been made of the *D*-line refractive indices at low temperatures of all known C_3-hydrocarbons with the exception of *cyclo*propene. For the molecular refraction the authors determined the hitherto unknown densities of *cyclo*propene and allene. Refractive indices and densities are recorded at temperatures between $-20°$ and $-80°$ and also at their respective normal boiling points. As the indices show wide differences, the authors suggest the data are of use in analysis, since binary mixtures of these hydrocarbons show a straight-line relationship. R. D. S.

1213. Kinetics of the Decomposition of *n*-Butane. II. Inhibition by Nitric Oxide and Propylene. L. S. Echols and R. N. Pease. *J. Amer. chem. Soc.*, 1939, **61**, 1024–1027.—Both nitric oxide and propylene inhibit the *n*-butane decomposition. The inhibition reaches a limit as the inhibitor concentration increases. It fades out as the reaction proceeds, the rate eventually becoming nearly equal to that of the normal decomposition. This phenomenon is attributed to the reversible formation of an intermediate.

These results are compared with the normal reaction, and the inference is drawn that there are two chain processes involved with only one type of carriers, or one mechanism concerned with the reversible inhibitor reaction. T. C. G. T.

1214. Density and Transition Points of Dotriacontane (Dicetyl). W. F. Seyer and W. Morris. *J. Amer. chem. Soc.*, 1939, **61**, 1114–1117.—Accurate measurements of the transition points of solid paraffin hydrocarbons, such as dicetyl, may be made by use of the dilatometer.

Pure dicetyl can be prepared from cetyl alcohol if sufficient recrystallizations are made.

The dicetyl prepared had a melting point of 69·6° and transition points at 69·5 and 63·5°. T. C. G. T.

1215. Dehydrogenation of *cyclo*-Octene. S. Goldwasser and H. S. Taylor. *J. Amer. chem. Soc.*, 1939, **61**, 1260–1263.—Catalytic dehydrogenation of *cyclo*-octene with chromium oxide gives styrene and not, as previous workers report, *cyclo*-octatetraene. *cyclo*-Octane is a secondary product, presumably by hydrogenation of the *cyclo*-octene with the hydrogen from its dehydrogenation. Up to 94% styrene was obtained.

Eight-membered rings tend to form six-membered rings at temperatures of 300° and over.

The apparatus used for the catalytic study of the vapours of hydrocarbons in the gasoline range is described. T. C. G. T.

1216. Catalytic Dehydration of C_5–C_8 Aliphatic Alcohols. S. Goldwasser and H. S. Taylor. *J. Amer. chem. Soc.*, 1939, **61**, 1751–1761.—Hexanol-1, 2-ethylbutanol-1, 2 : 4-dimethylpentanol-1, 2 : 4-dimethylpentanol-3, and 2-ethylhexanol-1 have been dehydrated using alumina, chromic oxide gel, and thoria catalysts. Uranium oxide was found to be inactive for dehydration.

The apparatus and procedure to separate the isomers resulting from the dehydration are described.

The ease of dehydration is shown to be correlated with the number of secondary hydrogens on the carbon second from that having the hydroxyl group. The elimination of water in this position causes the formation of an activated intermediate stage with the configuration of a 3-membered ring, and this in turn breaks down.

The effects of rate of passage and change of catalyst have been investigated and interpreted. T. C. G. T.

1217.* Viscosity of Gases Handled in Distillate Plants. W. L. Nelson. *Oil Gas J.*, 13.7.39, **38** (9), 50.—Data on the viscosity of high-pressure gas and of light liquids have been correlated and a chart drawn up showing the viscosity of normal paraffin hydrocarbons at different "reduced" temperatures and pressures (*i.e.*, actual temperatures and pressures in absolute units divided by the critical temperature and pressure, respectively). C. L. G.

1218.* Presence and Determination of Acetone and Methyl Ethyl Ketone in the Products of Low-Temperature Carbonization of Coal. E. A. Coulson and E. C. Holt. *J. Soc. chem. Ind.*, 1939, **58**, 267–270.—Samples of crude gas spirits from various low-temperature carbonization plants were examined with the object of determining the nature and amount of ketones present and the best method of rapid estimation of them. A successful method for the determination of the purity of acetone was found to be formation of the bisulphite compound by treatment with considerable excess of *N*-sodium bisulphite, removal of unused bisulphite with excess of iodine, and back-titration with thiosulphate. This gave results about 7% low for methyl ethyl ketone, but was used for comparing one sample with another. The different plants showed ketonic contents of 0·80–1·27%, made up of about 51% acetone, 33·4% methyl ethyl ketone, and 4·5% methyl *n*-propyl ketone containing ethyl propionate. The ketones were obtained by recovery from the bisulphite complex followed by fractionation. No ketones were found in the aqueous liquor from low-temperature carbonization. R. D. S.

1219.* Variations in the Physical and Chemical Properties of Castor Oil Due to Thermal Treatment under Different Conditions. F. Hawke and B. Segal. *J. Soc. chem. Ind.*, 1939, **58**, 270–272.—In order to ascertain the conditions of treatment to render castor oil completely miscible with mineral oils, samples were heated alone at different temperatures and pressures. The chief change occurring in such circumstances appeared to be one of decomposition, and not polymerization. Density did not change, but the V.I. was raised from 82 to, in one case, 128. It was observed that only heat treatment at 325° C. rendered the resultant oil (acetyl value 45–50) miscible with mineral oils. Above or below this temperature complete miscibility was not possible. Above 275° C. the residual oils showed an increase in acidity, decrease in the mean molecular weight of the fatty acids, increase in unsaturation, and decrease in acetyl value. Polymerization, which occurs extensively above 325° C., causes a greater tendency to oxidation. The authors observe that treatment must be carried out within strictly controlled temperatures and pressures to ensure complete miscibility with mineral oils, and that

the products, although possessing excellent viscosity characteristics, are more liable to sludge and gum than the raw castor oil, and are therefore poorer lubricants.

R. D. S.

1220.* Mechanism of Catalytic Phenylation and its Inhibition by Iron. H. H. Hodgson and E. Marsden. *J. Soc. chem. Ind.*, 1939, **58**, 290–292.—It has been previously shown that iodine and aniline phenylate α-naphthylamine by initial production of hydriodic acid, resulting in the formation of a complex which decomposes to give phenyl-α-naphthylamine and ammonium iodide. The latter then immediately dissociates to hydriodic acid, thereby enabling the reaction to continue. The authors here show that hydriodic acid is superior in catalytic powers to sulphuric and hydrochloric acids, but that these two acids are more efficient than hydrogen iodide in the phenylation of peri-acid. Quantitative phenylation experiments conducted with various mixtures of α-naphthylamine, aniline, and aniline hydriodide, with and without iodine, showed that the reactions were unimolecular.

Iron, whether in the form of iron vessels or introduced into the mixture as iron filings, definitely inhibited the action, but when the iron was rusted, phenylation occurred. Anhydrous ferrous oxide did not catalyse phenylation, whereas hydrated ferrous oxide was effective, due to its hydrolysis; wherefore it is suggested that clean iron forms ferrous iodide by withdrawing the catalyst (hydriodic acid), and so preventing phenylation, but that rusted iron forms ferrous iodide and water, so regenerating the catalyst and allowing the reaction to proceed. R. D. S.

1221.* Apparatus for Taking an Average Sample of a Variable Flow of Gas. A. Blackie. *J. Soc. chem. Ind.*, 1939, **58**, 293–296.—A description of an apparatus for obtaining an average sample of a flow of gas varying in velocity, pressure, density, and temperature. Two forms are proposed, one for small samples and one for larger samples.

R. D. S.

1222.* Thermochemical Aspects of Hydrogenation. R. Michel. *Oel u. Kohle*, 1939, **15**, 455–459.—On the hydrogenation of an unsaturated compound, changes of free energy content take place which are reflected in the heat of combustion. The share in the molar heat of combustion of a particular atom grouping is its heat value. For example, the heat of the $-CH_3$ group in ethane is 185 Cals., half the molar heat of combustion; similarly that of the CH_2 group in ethylene is 172·5 Cals. On the other hand, the heat value of a CH_2 group in a straight-chain paraffin—*e.g.*, decane or dotriacontane—comes out at 155 Cals. The difference between this value and that obtained from ethylene must be attributed to the presence of a double bond in the latter. Similarly the heat content of a CH group in dimethylpentane or dimethyloctane is 125 Cals., whilst in benzene it is 130·2 Cals. For the carbon atom itself, in the aliphatic series—*e.g.*, in trimethylbutane or hexamethylethane—the heat value is 95 Cals. Since the value for aliphatic CH is 125 Cals., the heat value of hydrogen is 30 Cals.; this confirms the independently derived values for CH_3 and CH_2, so in the aliphatic series we have the values: C, 95 Cals.; CH, 125 Cals.; CH_2, 155 Cals.; CH_3, 185 Cals.

On the other hand, the heat values for C in ethylene and in benzene are 112·5 and 100·2 Cals., respectively. Consequently, on hydrogenation, the carbon atom of the hydrogenated group will, in general, have a lower heat content than before, the addition of hydrogen resulting in evolution of energy. Thus the heat value of the carbon atoms is characteristic of the ability of an organic compound to take up hydrogen.

Examples are given showing the change in heat values of the carbon atoms as benzene is hydrogenated to *cyclo*hexane, and reasons put forward to explain why, in the successive hydrogenation of the poly*cyclo*pentadienes, the second two hydrogen atoms are added to the same ring as the first.

In the case of mixtures such as gasoline, a guide to the degree of hydrogenation possible can be obtained by determining an average heat value for the carbon present. This is calculated thus: the product of the number of gram atoms of hydrogen per 100 gms. sample and the heat value of hydrogen, is subtracted from the heat of combustion of 100 gms. sample, and the result divided by the number of gram atoms of carbon in 100 gms. sample.

The author shows how this method can be extended to coals, the elementary analyses

and heats of combustion of which are known, and gives as examples a sample of Silesian coal and a lignite. In the former case the heat value is 101·3 Cals., and in the latter 96·25 Cals., showing that the coal contains unsaturated carbon, whilst the lignite is already largely saturated. T. T. D.

Analysis and Testing.

1223.* Accelerated Oxidation Test for Oils. W. Francis and K. R. Garrett. *J. Inst. Petrol.*, 1939, **25**, 561–565.—A new method for determining the oxidizability of oil is described, using a solution of alkaline potassium permanganate under standard conditions as the oxidizing agent. It is claimed the method can be used to ascertain the state of oxidation of an old oil. G. R. N.

1224.* Colour Density and Acid Vapour Indicate Oil Performance. (Vide *Proceedings 12th National Meeting of the Oil and Gas Power Divisions*, The American Society of Mechanical Engineers, June 1939.) W. F. Weiland. *Nat. Petrol. News*, 9.8.39, **31** (32), R.334–R.338.—It is stated that the performance of a motor oil may be predicted and its useful service life determined by the determination of the colour density ratio, or oxidation number, and the minimum acid-vapour temperature. The colour density ratio is obtained by comparing the depth of colour of an oil before and after oxidation under controlled conditions, or before and after normal use. The minimum acid-vapour temperature is that at which the oil first produces acid vapours when placed under a slight vacuum in a bath at 350–360° F., the acid vapours being detected by litmus. The minimum acid–vapour temperature is stated to fall rapidly as oxidation proceeds, and to be closely related with the rate of visible sludge formation and oil breakdown. Graphical data for a number of typical oils are presented. H. G.

Motor Fuels.

1225.* High-Octane Fuel Containing *iso*Propyl Ether. E. I. Zabryanski. *Neft. Khoz.*, June 1939, **20** (6), 39–42.—Baku and Koschagil gasolines blended with 40% *iso*propyl ether have an octane number of 97–98 (C.F.R. Motor Method). Volatility and vapour pressure of blends are within the limits of American standards for aviation gasolines. Starting properties of Baku B-70 gasoline are improved by the addition of *iso*propyl ether.

When 30–40% *iso*propyl ether and 3·0 cu. cm./kgm. T.E.L. are added to Baku B-78 residual gasoline, an octane number of 95–97 (Motor Method) is obtained with satisfactory volatility. By addition of 30–40% *iso*propyl ether and T.E.L. to Grosny aviation gasoline or desulphurized Ishimbaevo gasoline, 91–95 octane fuels are obtained. Maximum octane number improvements result when *iso*propyl ether is added to low octane fuels. L. R.

Lubricants and Lubrication.

1226.* Service Tests with Lubricants for High Speed Oil Engines. A. T. Wilford. *J. Inst. Petrol.*, 1939, **25**, 607–622.—A paper with discussion on lubricating oil tests carried out by the London Passenger Transport Board during the past seven years with special reference to the quality of lubricating oil required for oil-engined buses. G. R. N.

1227.* Lubrication of the Modern Commercial Vehicle Chassis. F. C. Whitehouse. *J. Inst. Petrol.*, 1939, **25**, 623–628.—A paper, presented for discussion, relating to the lubrication problems that have been encountered in the development of the light fast commercial vehicle. G. R. N.

1228.* Automobile Manufacturer's Selection of Lubricants. K. Brozyna. *J. Inst. Petrol.*, 1939, **25**, 629–642.—A paper, which, after discussing the desirable qualities of car lubricants, gives an approved selection of the various types required. G. R. N.

1229.* Function of Colloidal Graphite in Special Purpose Lubes. R. Szynanowitz. *Nat. Petrol. News*, 9.8.39, **31** (32), R.340–R.342.—Colloidal graphite, electric furnace graphite, is now available in stable suspension in low viscosity carriers such as dilute glycerine, benzol, carbon tetrachloride, triethanolamine, etc. Such materials find extensive use as penetrating oils to help solve lubrication problems where ordinary lubricants are not completely satisfactory. Colloidal graphite is occluded in the surface and functions as an efficient lubricant after the rupture of the lubricant film in the usual sense. Dispersed in glycerine, colloidal graphite is a good lubricant for rubber, and in a volatile carrier solves many problems of high-temperature lubrication where full-film lubrication with a mineral oil is not possible. Used as an additive to mineral oil in "running-in," danger from film rupture is reduced. Being "truly colloidal," this graphite introduces no difficulties that might be attendant upon a tendency to settle out. H. G.

1230.* Studies in Non-Fluid Lubrication. Pt. I. S. Kyropoulos. *Refiner*, 1939, **18** (7), 273.—By means of a simple apparatus and microscopic observation, the dependency of surface wear and polish on the characteristics of the lubricant was studied. An electrical effect was found to be responsible for wear in contrast to polish in the presence of solid (*e.g.*, wear) particles. The lubricating efficiency of an oil may be increased by excluding the electric effect and its resulting effects. This may be done by direct electrical connection of the surfaces and/or by discharging the surfaces and particles by means of imparting electrical conductivity to the oil. Polar substances, added to the oil, perform this discharge directly or indirectly. Their effect is in low concentrations proportional to the resulting conductivity of the oil. The magnitude of the electrical field strengths is such that it may lead to the building up of field currents at the peaks which will tend to promote seizure. The electrical effect originates in fluid lubrication and leads to local non-fluid lubrication in small clearances.
G. R. N.

1231.* Effect of Fatty Acid Derivatives on Lubricants. A. W. Ralston, E. J. Hoffman, and E. W. Segebrecht. *Nat. Petrol. News*, 26.7.39, **31** (30), R.320–R.322.—Using the technique previously described, (*Nat. Petrol. News*, 3.11.37, Abstract No. 62 (1938)), the effect on the lubricating efficiency of hydrocarbon oil to which sundry fatty acid derivatives were added was examined. The alkyl esters of saturated and unsaturated fatty acids and sundry thio esters were used. The results indicated that all the additives reduced frictional forces, that the saturated fatty acid derivatives were superior to those of unsaturated fatty acids, and that the thio esters were less efficient than the corresponding oxygen esters. It is assumed that the esters function by virtue of their adsorption at the metal surface, and that the point of attachment is the carboxyl group. It is further assumed that the greater the difference between the radicles R and R^1 in the ester R·COO·R^1, the greater would be the polarity and the greater the efficiency as a lubricant additive. These assumptions were not borne out by the results. Indeed, often the reverse is true. H. G.

Asphalt and Bitumen.

1232.* Development in Bitumen Plastics. W. H. Cambden. *Chem. & Ind.*, 1939, **58**, 867–868.—A review of the uses of bitumen for moulded articles for electrical purposes. The incorporation of fillers, such as asbestos, has, in the opinion of the author, opened considerable new fields, and it would appear to be wrong to assume that bitumen is losing ground in the plastic industry. T. C. G. T.

1233.* Measurement of the Flow Properties of Bitumens. D. C. Broome. *J. Inst. Petrol.*, 1939, **25**, 509–530.—The use of routine apparatus in determining flow criteria is adversely discussed and some modifications are suggested. Of the various viscometers the rotating cylinder type is preferred, and data obtained with it are examined in the light of the conceptions of plasticity, thixotropy, age hardening, and elastic recovery. G. R. N.

1234.* Bitumen Emulsions. L. G. Gabriel. *J. Inst. Petrol.*, 1939, **25**, 531–557.—The development of and various problems in the manufacture of bituminous emulsions are

sketched. Sedimentation behaviour and physico-chemical factors underlying the viscosity/concentration relationships of these emulsions are discussed. Various uses of the emulsions in industry are described and the mechanism of breakdown in various circumstances is analysed. G. R. N.

1235.* Production of Bitumen from Residue of Ishimbaevo Crude. G. P. Grigoryev and N. S. Ruzankin. *Neft. Khoz.*, March 1939, **20** (3), 53–55.—The process of conversion of Ishimbaevo residue into bitumen is carried out at temperatures above 240° C. After 7 hr. air-blowing, active bitumen formation begins. Temperature has a decisive effect on the oxidation of the residue. The high content of sulphur compounds in Ishimbaevo residue has a very beneficial effect on the process of bitumen formation, the sulphur compounds acting as catalysts.

Optimum conditions for bitumen formation are: Temperature, about 300° C.; air consumption about 5 litres/min. per 1 kgm. oxidized residual oil. Yield figures, when producing from Ishimbaevo oil goudron, are as follows: 19–20% of the crude, and 31–32% of the residual oil. When the oil residue is oxidized directly, 37–38% of the crude or 61–62% of the residue are obtained.

Roofing felt prepared with the bitumen obtained showed satisfactory weathering resistance and had good waterproof qualities. L. R.

1236.* Soil Stabilization by Heat Treatment. G. W. Eckert. *Chem. & Ind.*, 1939, **58**, 846–851.—The problem of producing a reasonable road surface by heat treatment of the soil has received attention in the U.S.A. and in Australia. Experiments were carried out in America prior to 1890. Generally the procedure has been to remove strips of clay from the surface and roast it by various means, such as roadside fires, and replace the roasted clay and roll it in.

A machine has been developed by L. R. H. Irvine in Australia for the direct heating of surface soil to make a durable road surface which offers great promise. The Australian machine which has been in operation in Queensland for four years consists of a furnace suspended within a wheeled chassis. The heat is obtained by the burning of a gas generated by a producer using wood fuel. The flame, under pressure from a fan, is directed on to the soil. The machine has an overall length of 33 ft., width 9 ft., and weighs about 25 tons. It is claimed that this machine heats the surface effectively to a depth of about 6 in., and that the cost of one mile of road construction with it is $3500.

Temperatures of 400–700° C. are necessary in the successful treatment of soil, as at these temperatures the crystal lattice structure of the clays is disrupted with release of OH ions.

If the soil is heated sufficiently long at the higher temperature, a hard, compact, and only slightly brittle product ensues. Its binding strength will be due to interlocking crystallization films of glassy silicates and oxides of iron and alumina.

Bitumen binders are desirable mediums for binding and waterproofing the soil. T. C. G. T.

1237.* Gilsonite. F. R. Jones. *Chem. & Ind.*, 1939, **58**, 800–801.—A brief review of the origin, mining, properties, and uses of Gilsonite. T. C. G. T.

Special Products.

1238. Synthetic Fatty Acids. Developments in the Paraffin Oxidation Method. Anon. *Chem. Tr. J.*, 4.8.1939, 105–107.—The production of fatty acids for soap-making or edible purposes from the oxidation of Fischer–Tropsch residues is rendered difficult in practice by the incompleteness of the oxidation, necessitating recycling, and by the formation of undue amounts of oxy-fatty acids. E.P. 506,104 of 1938 granted to Vereinigte Oelfabriken Hubbe und Farenholtz of Magdeburg describes a method of overcoming these difficulties, based on the fact that the presence of volatile oxidation reaction products accelerates the oxidation reaction. A multi-stage process is accordingly used in which a current of air or other oxidizing gas is passed through the several reaction vessels, addition amounts of air, etc., being introduced throughout

the different stages. It is believed that there is an optimum hydrogen ion concentration (within the slightly acid range) for the production of fatty acids, and this is maintained by the introduction, primary formation, and removal of the more readily volatile oxidation products. The consumption of air, owing to the more effective utilization of oxygen, is also reduced. Using 0·3% of magnesium stearate catalyst, oxidation of Fischer–Tropsch paraffin at 120° to 125° C. for 36 hr. in a three-stage process gave products of acid value 93, 111, and 125 respectively, in the three vessels, with initial boiling points under 14/16 mm. pressure of 151–157° C. C. L. G.

1239.* Trends of Progress in Oils and Fats (Other than Edible) and Detergents. P. W. Tainsh. *Chem. & Ind.*, 1939, **58** (25), 587–591.—Although hardened whale oil is an almost perfect substitute for tallow in soap-making, its future is considered uncertain because of the rapid depletion in the stock of whales. In the season 1937–1938, 46,039 whales were caught, and these produced 557,000 tons of oil. This is classified according to free fatty acid content and colour in four grades, Nos. 1–4. Next in importance is palm oil, with an annual world production of about 500,000 tons. The plantation system is now in operation in W. Africa, Dutch East Indies, and Malaya, the last two localities accounting for almost 50% of the world's output. The oils in the nut-oil class, mainly coconut oil and palm-kernel oil, account for 20–25% of the oils used in soap-making. They give to soap special properties connected with lather, solubility, and texture. As regards soya-bean oil, a member of the soft oil class which includes cottonseed oil and groundnut oil, 500,000 tons were produced in 1938. Cultivation has increased enormously in the U.S.A., but in England efforts to find a bean suitable for cultivation have not been very successful. Of other alternatives, chief interest is in fatty acids from the oxidation of selected petroleum fractions, or from materials amongst the products of the Fischer–Tropsch synthesis, or from coal as the raw material. In Germany it is expected that a full-scale plant for producing synthetic fatty acids will be in operation by the end of 1939. Progress in the methods of treating oils and fats by bleaching and hydrogenation is seen in the use of activated earths and of selection of suitable catalysts and controlled temperatures. Progress in transport has witnessed the replacement of barrels by bulk methods, and the consequent almost complete disappearance of the melting process. A problem at present receiving attention is the research into anti-oxidants, necessary owing to the removal or destruction of natural inhibitors in the oil or fat when heated. Incidentally an anti-oxidant is considered to work by absorbing energy liberated in the reaction chain, thus preventing further activation of the autoxidizable fat. The Lea test for rancidity measures the peroxide content of oxidized fats and is considered to have stimulated research in the field of anti-oxidants. So far efforts to replace the old batch process of soap-making by a continuous process have not been very successful. The mechanism of saponification is considered to be a homogeneous reaction taking place in solution. The soap itself, on account of its micelle nature, is the solvent for the oil and the alkali. Improvements in processing include the use of centrifugal and filtering methods and of cold air or running cold water in cooling bars and slabs of soap or thin films in drums. Drying has been improved in the direction of utilizing both the forward and return motion of the net or band carrying the soap, and also in reheating and re-circulating the air used for drying. Milling for soap flakes is now done in temperature-controlled chilled cast-iron drums having precision ground surfaces and producing flakes of a thickness of between 0·001 and 0·002 in. Toilet soaps and soap powders and bleaching soaps have likewise been improved, the first named to retain colour and perfume. Of more than passing interest are the soapless detergents now being developed for use with hard water to overcome the objection of the precipitation of insoluble calcium and magnesium soaps. Use of preparations from sulphonated castor oil was not encouraging, as detergent properties were not good. Other compounds prepared and used are the so-called Gardinols, obtained from the sulphation of aliphatic alcohols derived from C_{12}–C_{18} straight-chain hydrocarbons, also condensation products of fatty acids with isethionic acid, *e.g.*, the oleyl ester of the sodium salt of isethionic acid, also compounds from the reaction between fatty acid chlorides and methyl taurine, and lastly the Igepons obtained by the sulphonation of the products of reaction of high-mol.-wt. phenols and ethylene oxide. For general purposes the soapless detergents are still inferior to soap, but find special application in the treatment of woollen fabrics and for shampooing. J. L. T.

1240. *Chemistry of Solid Carbon. H. L. Riley. *Chem. & Ind.*, 1939, **58** (17), 391–398.—This detailed study gives an account of the X-ray diffraction methods of analysis of the various forms of black carbon. In graphite, the carbon atoms are arranged hexagonally in flat layers, and when graphite salts are formed, the hexagonal layers remain intact and the anion penetrates in between them. A description, based on X-ray data, is given of the process of carbonization, and from these are obtained the structures of cokes which are confirmed by chemical investigations into the properties of the cokes at various temperatures. When the carbonizing temperature is about 700° C., changes occur which greatly affect the resulting cokes. The effects at this temperature (which are enumerated) are responsible for the differences between low-temperature and high-temperature cokes. The factors determining the mechanical strength of coke provide further confirmation of such interpretation of results.

R. D. S.

Detonation and Engines.

1241.* New Laboratory Method for Rating High Octane Aviation Fuels. R. Stansfield and H. B. Taylor. *J. Inst. Petrol.*, 1939, **25**, 566–572.—A cathode-ray oscillograph and an indicating unit showing rate of change of pressure diagrams were employed with the C.F.R. engine in devising running conditions from which a measure of the rating of aviation fuels of high octane number (87 +) could be obtained.

G. R. N.

1242.* New Stream-Line Oil Filter. Anon. *Chem. & Ind.*, 1939, **58** (25), 601.—In announcing the M.C.7 type filter for fitting actually on to the engine of a commercial vehicle, the familiar claims for minimum attention and longer life of the lubricant are stressed.

J. L. T.

1243.* Automotive Type Engine Drives. J. C. Albright. *Refiner*, 1939, **18** (5), 212.—At the Fairfax, Oklahoma, gasoline plants of the Skelly Oil Co. well-known makes of motor-car engines have been adapted to run on plant gas and provide motive power for water and absorber oil circulation pumps. A short account is given. G. R. N.

1244.* Operating Costs of Petrol and Compression Ignition-Engined Buses. W. C. Whalley. *J. Inst. Petrol.*, 1939, **25**, 573–606.—A lecture, with discussion, showing the saving effected when C.1 engines replaced petrol engines as the prime mover in buses.

G. R. N.

Economics and Statistics.

1245.* Review of the Trinidad Petroleum Industry During the Period 1934–1938. V. Bryan. *Monit. Petr. roum.*, 1939, **40**, 1251–1254.—During 1934 the Trinidad petroleum industry showed the first signs of recovering from the 1930 depression. In that year the island achieved its record production, to that date, of 1,492,528 tonnes. Each year since has seen an increase in this record, until, in 1938, the production was 62·8% higher than in 1934, at 2,430,000 tonnes. 95·3% of this production was processed during the year.

Other interesting statistics of the industry in Trinidad are: (1) The total area of the island is 4300 sq. km., of which 2295 are petroleum concessions. (2) The production of natural gas in 1938 was 523,900,000 cub. ms. (3) 2641 wells have been drilled in Trinidad, of which 1304 are in production. Of these 428 are under pressure and account for 69·7% of the annual production, 516 are being pumped and yield 19·8% of the production, whilst other means—*e.g.*, gas lift—account for the remaining 10·5%. Drilling was started on 279 wells in 1938. (4) The oil produced is of asphaltic base, and ranges in gravity from 47° to 14°. (5) Annual internal consumption of petroleum products is 13,342 tonnes of spirit and 3150 tonnes of lamp oil.

Petroleum to the value of $23,656,561 was exported in 1938, and this represents 69% of the island's trade. Bunker fuel is at the head of petroleum exports, with a value of $11,348,699.

The island has four deep-water jetties for loading tankers, and has a storage capacity of about 600,000 tonnes, which is being increased to 700,000 tonnes.

With increasing evidence of vast petroleum reserves, it is apparent that the industry in Trinidad has a very bright future.

T. C. G. T.

BOOK REVIEWS.

Famous Cities of Iran. By Dr. L. Lockhart. Pp. 115. Illustrations 65 + 2 maps. Walter Pearce & Co., The St. George's Press, Brentford, Middlx. Price 7*s.* 6*d.*

Translation of a Review in French by M. Maurice Mercier.

No one could be better qualified than Dr. Laurence Lockhart to give us an historical sketch and description of the most famous towns of Iran, that will satisfy at the same time the demands of the bibliographer and the curiosity of the ordinary traveller.

It is true that the *Nafi* Magazine has already given us the first publication of the various chapters describing these enchanting cities, the very names of which are enough to plunge us into the realms of fantasy and imagination: Tehran, Isfahan, Tabriz, Meshed, Shiraz, Qazvin, Nishapur, Hamadan, Kermanshah, Yezd, Kerman, Kashan, Qum, Shushtar, Ardabil, Bandar'Abbas; but the publication in one volume of so many monographs is of particular interest, and will be welcomed by all who have enjoyed the original articles.

Dr. Lockhart's long residence in Iran, his knowledge of the inhabitants and of their customs and history, his numerous bibliographical references, and his notes, have enabled him to produce within the covers of a moderately sized book a work of the first order. If it is further stated that his book is illustrated in a most delightful way, one will already have some idea of what this publication is like, coming after so many others by the same author.

Reference to the bibliography shows that Dr. Lockhart has not been content merely to consult the accounts of European travellers such as Chardin, Sir Thomas Herbert, E. Herzfeld, Sir A. H. Layard, G. Le Strange, James Morier, Samuel Purchas, Sir P. M. Sykes, not to mention the fundamental works of J. de Morgan and of Sir J. Malcolm, but he has also referred to Arab and Persian travellers such as Hamdullah Mustaufi, Ibn Battuta, Al Istakhri, Al-Muqaddasi, Nasir-i-Khusrau and finally Yaqut.

It must have been difficult to combine in a work collected together in such a concise way so much charm and real quality. If the preparation of this book has been only a form of recreation for Dr. Lockhart, it is a great joy for the reader, and let us remember that it is often the light books which are the most difficult to produce.

I feel that Dr. Lockhart, with his alluring descriptions, has given us his "rubai 'at" after Omar Khayyám, and I do not think that from the point of English literature a greater measure of praise could be accorded to it: moreover, the foreword by Lord Cadman is in itself an incomparable testimony to the merit of this book.

M. Mercier.

A.S.T.M. Standards on Petroleum Products and Lubricants. Prepared by Committee D-2 on Petroleum Products and Lubricants September 1939. Pp. ix + 336. American Society for Testing Materials, 260 S. Broad Street, Philadelphia, Penna. Price $2.

The A.S.T.M. Standards on Petroleum Products and Lubricants, prepared by Committee D-2 of the American Society for Testing Materials, and issued in September 1939, includes a number of modifications of previous methods of test. The more important of these are the introduction of new tentative standard methods of Test for Carbon Residue of Petroleum Products (Ramsbottom carbon residue), for Gum Stability of Gasoline, and for Tetraethyl Lead in Gasoline. In the report it is stated that better reproducibility was obtained with the Ramsbottom method than with the Conradson method. Technical Committee A on Gasoline reports an investigation of three methods of test for determining gum stability, the bomb method, low-pressure-induction method test, and the copper-dish test. Correlation with storage tests were carried out, and the work described has extended over the last five years. It is considered that the copper-dish test gives unsatisfactory reproducibility, and

the tentative method of test recommended is based on the induction period measured in the bomb test, as this method of test is more generally used in the industry. The method for tetraethyl lead is a modification of one originally devised by the Imperial Oil Company of Canada.

There are a number of revisions of tentative standards, including the tentative method of test for Kinematic Viscosity, 445/39-T, in which any apparatus of a capillary type capable of measuring viscosities with an error not greater than 0·2 per cent. is now permitted; pure distilled water is to be used as the primary viscosity standard, but oil samples may be used as secondary standards.

Amongst the standard methods of test which have been revised is the burning test of burning oils D 181-39 for which a method of test is also under consideration by the Kerosine Sub-Committee of the Institute which should be issued shortly.

Three tentative methods have been advanced to standard, including the method of test for knock characteristics of motor fuels.

In so far as petroleum products are concerned the A.S.T.M. D-2 Committee now includes proposed specifications for aviation gasoline and tentative specifications for fuel oils, gasoline, Stoddard solvent and petroleum spirits in addition to emulsified asphalts. The 1938 Report also included a diesel fuel classification.

There is also included in the report of A.S.T.M. D-2 Committee for 1938, Standard Definitions of Terms relating to Petroleum D288-39, which have been advanced to Standard from Tentative Standard. F. H. GARNER.

BOOKS RECEIVED.

The Hydrogenation-Cracking of Tars. Part V. The Operation of a Semi-Technical-Scale Plant. D.S.I.R. Fuel Research Tech. Paper No. 51. Pp. 30. H.M. Stationery Office, London. Price 1*s*.

This report describes the results obtained in a semi-technical-scale plant at the Fuel Research Station, designed to treat from 200 to 400 gal. of raw materials per day. The raw materials consist of hydrogen, and low-temperature tar from the Fuel Research Station's narrow brick retorts, to which is added a controlled proportion of "recycle oil." The amounts and analyses of the materials produced under different operating conditions are given, and comparisons are made with the corresponding results from the small-scale converters. The operation of the plant appears to have been very satisfactory, and has shown that the results of treating low-temperature tar are similar to those obtained in small-scale experimental plants.

Technology, Employment, and Output per Man in Petroleum and Natural-Gas Production. Works Project Administration National Research Project and Department of the Interior, Bureau of Mines. Report No. E.-10. 1939. Pp. 347. Federal Works Agency, Works Project Administration, 1734 New York Avenue, N.W.

This report presents a detailed examination of the past record and present status of the industry in question, with a view to indicating the future trends of output and man-power requirements. The long-time trends of production are first developed to indicate whether these trends are likely to continue or change their present course. The trends of employment are next examined for an understanding of significant influences that have affected the size and character of the industry's working force. Technology is then studied to determine the labour-saving that has attended successive technical advances in the past, and to ascertain possible effects of impending technical improvements.

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Geology.

1246.* Structural and Magmatic Processes in the Isostatic Layer. M. G. Hoffman. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 1320–1351.—The Isostatic Layer is here referred to the outer 60 miles of the earth. This is made up, from the surface, as follows: a layer of approximately 10 miles composed largely of sediments and granitic rock, followed by an intermediate layer, from 15 to 20 miles thick, of basic crystalline rocks (gabbros, etc.), and a 30-mile layer of glassy basalt or tachylyte. This tachylyte layer is thought to be universal, and extends from the base of the intermediate division to the top of a dunite layer, 1800 miles thick, which rests on the liquid core.

Folding and faulting of strata in the earth's crust—that portion above the isostatic layer—indicate that the crust has been shortened. This is shown by its collapse on a shrinking interior. The temperature of the isostatic layer remains essentially constant while the interior cools and shrinks. Stresses in the crust continue until breaking point is reached, when relief is brought by folding and faulting.

Mountainous areas are reduced by erosion, and down-warped areas are filled with great masses of sediments, isostatic balance being maintained during these processes.

The filling of basins and the reduction of mountain systems bring about changes in base level and the position of the isogeotherms. The amount of deepening caused by thermal changes may be 800–1000 ft., and that from rising strand line 700 or 800 ft. Thus, by a combination of both, about an additional 9000 ft. of sediments may be assigned to the basin, and the total thickness would be 21,000 ft.

Crustal collapse will fold these sediments into a great mountain system. To maintain the isostatic balance, the beds must be downfolded about six miles for every mile of upfolding. Tangential compressive stresses will be dominant, and the great amount of shortening which will occur in the geosynclinal prisms will give rise to intense crumpling, overturned folds, and thrust faults.

After the mountain system is moulded and crystal equilibrium established, the main movements will be vertical. Erosion of the high levels will disturb the isostatic balance and the adjustment will be upward. Final erosion of this mountain system will result in the isogeotherms being above normal, and on their return to normal the consequent shrinkage will give rise to a basin where once stood a mountain range. Thus, a mountain system which has been base-levelled can become the site of a new geosyncline merely as a result of temperature adjustments. A series of diagrams illustrates the course of events in the history of a mountain system.

The concluding section of this paper is devoted to the origin of a magma, and diagrams are also furnished showing the various stages in its formation. G. S. S.

1247.* Salem Oil-field Marion County, Illinois. H. H. Arnold, Jr. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 1352–1373.—This paper deals particularly with the stratigraphy and structural geology of the Salem Oil-field.

A thick mantle of glacial material (40–60 ft.) covers the bed-rock of the area. From a drill-section—which is figured—the sequence of subsurface rocks shows approximately 1100 ft. of Pennsylvanian sediments represented by the McLeansboro, Carbondale, and Pottsville series. These consist of alternating shales and sandstones, together with thin limestones and coals.

The Pennsylvanian is followed by approximately 750 ft. of Mississippian sediments, of which about 680 ft. is represented by the Chester series, consisting of vari-coloured shales, sandstones, and crystalline limestones. The oldest rocks of the Mississippian reached by drilling were those of the Meramec group, the upper member of which is the St. Genevieve limestone.

Indications of early structural movements are evident in the Illinois basin, so much so that definite controlling influences were probably formed by these disturbances. Structural maps and cross sections of the Salem field are provided.

Production is obtained from the Mississippian, viz. the Chester series (Benoist Sand and Aux Vases Sand), and the Meramec (McClosky oolitic limestone). Oil has not been encountered in the Pennsylvanian rocks. The average daily production during June 1939 was 133,643 brl. and the total production for the entire pool (to July 1, 1939) was 20,080,000 brl.

Tables giving production data are included in the paper. G. S. S.

1248.* Jackson Eocene from Borings at Greenville, Mississippi. H. N. Fisk. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**. 1393–1403.—The author describes a series of six middle Jackson Eocene cores from borings recently drilled in the alluvial-masked Mississippi River valley. The samples were taken at approximately 100-ft. depths along the water-front at Greenville. A cross-section is given showing thickness of Recent alluvium and position of samples in each boring.

From a study of the foraminifera found in the samples, it appears that the Jackson beds constitute the lower part of the *Textularia hockleyensis* zone and the upper part of the *Textularia dibollensis* zone. The junction of these zones has a westerly dip towards the Arkansas syncline, the axis of which is traceable to the south around the edge of the Monroe uplift into West Central Mississippi. G. S. S.

1249.* Illinois Geologic Trends Better Defined. W. V. Howard. *Oil Gas J.*, 26.10.39, **38** (24), 34.—Recent work has led to the general recognition of the importance of pre-Pennsylvanian structural movements. In addition to the Carlenville–Centralia and the parallel Ava–Dupo anticlinal trend, alignment along other north-west to south-east areas can be seen elsewhere in the basin. The subordinate north to south structural trend is becoming more apparent in the elongation and alignment of fields in this direction. The north-north-east to south-south-west trend is most evident in the south-eastern part of the basin in the Cione–Noble and Storms–Allendale trends.

The number of potential pay horizons has been increased, notably in the Chester series, where the Aux Vases, Renault, Tar Springs, Paint Creek, and Waltersburg sands have proved productive. The pre-Mississippian formations are disappointing, although the Devonian–Silurian (Niagaran) and Trenton have given provocative scattered production.

Details are given of wildcatting in the first nine months of 1939. Practically all the tests to pre-Mississippian horizons have been on the northern and western rims of the deep basin. Some of the new fields and the trends are briefly noted and a table gives the depths of the principal producing horizons. G. D. H.

1250.* Six Horizons Producing along Wabash Valley. K. A. Spitznagel and H. Moore. *Oil Gas J.*, 26.10.39, **38** (24), 54.—Nine oil-pools and one gas-well have been found in five months in the Wabash Valley. These run for 35 ml. and yield oil from the McClosky lime, Aux Vases sand, Cypress sand, Tar Springs sand, Waltersburg sand, and Biehl sand. The oil-fields of the Wabash Valley are only partly adjusted to structure. The Griffin trend is a series of highs aligned north-east to south-west. The producing horizons are lenticular. However, the McClosky lime production is entirely structural. The fields are yet too young for accurate estimates of recoveries, but the Cypress is put at 250 brl./acre-ft., Waltersburg 300 brl./acre-ft., McClosky 100–600 brl./acre-ft.

The Griffin pool yields oil from four horizons : the McClosky, 9 ft. thick ; the Cypress, 18 ft. thick ; the Waltersburg, 33 ft. thick ; and the Tar Springs, sand. 500 acres have been proved in the Waltersburg sand pool on Ribeyre Island. 45 wells have been completed in the Keensburg pool. Information is given about some of the smaller fields and a stratum contour map is included. G. D. H.

1251.* Reserves of Illinois Exceed 500,000,000 Barrels. H. F. Simons. *Oil Gas J.*, 26.10.39, **38** (24), 58.—Exploration during the past three years has revealed reserves of 495,132,000 brl. recoverable from nearly 56,000 acres, and during that period the production from the Illinois basin has been 70,237,173 brl. Most of the reserve lies in two major fields—Louden 182,000,000 brl., and Salem 200,000,000 brl. The former has produced 11,909,452 brl. and the latter 30,688,632 brl. of oil. Louden was discovered late in 1937, and Salem in midyear 1938. Both have over 1100 wells, and Louden is productive from the Cypress, Paint Creek, and Bethel sands, and Salem from the Benoist and Aux Vases sands and the McClosky lime.

The reserve estimate of 15,000,000 brl. for the Griffin area may have to be raised later, for all the pay horizons are discontinuous, rendering assessment dependent on detailed drilling. This area yields oil from the McClosky lime, the Cypress, Waltersburg, Tar Springs, and Biehl sands.

The Illinois basin is being depleted rather rapidly and it is unlikely that the present high discovery rate will be maintained. G. D. H.

1252.* Introduction to the Geology of North-west Peru and South-west Ecuador. A. Olsson. *Ann. off. Combust. liq.*, May 1939, **14**, 551–604.—The oil-fields of north-west Peru and western Ecuador are in the Tertiary zone along the Pacific coast. Outcropping beds range Upper Palæozoic to Recent. The oldest dated rocks are Pennsylvanian, and occur in the Amotape Range. These are overlain in places by Cretaceous limestones and shales, sandstones, and conglomerates of Aptian to Maestrichtian age. Representatives of the Trias, Jurassic, and Neocomian are known only in the south. Because of their economic importance, the Tertiaries have been studied in detail. Wide areas of Tertiary are covered by Quaternary tablazos. The stratigraphy is described in some detail. In the coastal region the Tertiary is 8000–10,000 m. thick, although there are wide variations in thickness. Lithologically the Tertiary consists of alternating shales, sandstones, and conglomerates, with only minor limestone beds.

The main structural features of north Peru are the Andean chain and Amotape Mountains, with the Pacific deep in the west. Between these are Tertiary deposits, folded and faulted. On the La Brea–Negritos anticline the main Peruvian oil-fields are developed.

Zorritos produced from the Miocene on a narrow block fault. At Cabo Blanco and Restin oil is obtained from the Eocene on a complexly faulted structure. The Lobitos field yields oil from a fold. The very extensive and important La Brea–Parinas field is on a large fractured dome, and derives oil from the Middle Eocene.

In the main, the geology of south-west Ecuador resembles that of Peru, but on the Santa Elena peninsula there are overturning, profound silicification and eruptive rocks. The Eocene rests unconformably on older disturbed beds. In the Oligocene are bituminous shales, but Miocene beds are unknown on the Santa Elena peninsula. There are many signs of oil, mainly in the zone of silicified and eruptive rocks. Eocene oil sands outcrop on the coast, and in this region is the main Eucadoran oil-field giving oil from the Eocene at depths of 200–800 m. G. D. H.

1253.* Oil-fields in Peru. J. E. Rassmuss. *Petrol. Z.*, 1939, **35** (32), 581–591.—A detailed geological and economical survey is given of the Peruvian oil-fields. The oil-field of northern Peru between Bayovor and Zorritos will continue to be of outstanding economic importance. A very rich field is situated in the Amazonas territory near Agua Caliente on the Rio Ucayali. In the neighbourhood of the oil-fields, this river has a width of 800 yd. and a depth of 8–20 ft., according to seasonal fluctuations. This field will, therefore, be of great importance in the future supply of Brazil, to which country the oil can be shipped in tankers. All other fields will never be of more than local value. E. W. S.

1254.* Geologic Structure and Oil Content of Syukeyevsko–Uleminski Rayon. A. M. Melnikov and V. F. Yakovlev. *Neft. Khoz.*, June 1939, **20** (6), 14–17.—The Syukeyevsko–Uleminski rayon is situated in the western area of the Tartar Republic on the right bank of the Volga river, 100 km. downstream of Kazan. The tectonic structure is discussed in detail, and conclusions are given from geophysical data available. Bitumen and sulphur are found on the earth surface at many places, the former being taken as an indication of oil-carrying strata at greater depths. The importance of thoroughly prospecting the rayon is stressed. L. R.

1255.* There is Oil in France. Anon. *Rev. Pétrolif.*, 28.7.39 (848), 986–987.—Bertrand has indicated the importance of the area along the northern margin of the Pyrenees in regard to oil prospects. Although about fifty wells were drilled in the Basses–Pyrenees and Landes, the absence of surface oil indications probably deterred searchers in Haute-Garonne. After various people had taken up concessions and renounced them, in 1938 the O.N.C.L. took up a concession of 49 sq. km. The first well found marls with thin sandstone bands intercalated down to 1430 m. Deeper there were Cenomanian limestones and conglomerates, which could form good reservoir rocks, under a thick, impermeable cover. At 1460 m. there was a gas flow, and a second

one at 1520–1530 m., which gave 183,000 cu. metres/day. The presence of butane and higher homologues in the gas points to the possibility of its being associated with oil. G. D. H.

1256.* Important Discovery of Natural Gas in Haute-Garonne. Anon. *Rev. Pétrol.*, 21.7.39 (847), 955.—The Saint-Marcat anticline near Saint Gaudens (Haute-Garonne) was examined geophysically and by shallow borings. The first well was abandoned, and the second, possibly on the crest, had revealed a flow of gas which may well be associated with oil, at a depth of 1520–1530 m. An estimated production of 200,000 cu. metres/day was obtained.

A well is to be drilled to test the flank at Pic Saint-Loup, near Montpellier.

Gas has also been found at Lussat, Pont-du-Chateau, Chamailliere, Espirat, Macholles, Puy de la Poix, Puy Crouelle, etc. The best-known occurrence was at Vaux, where a well in 1920 gave gas under a pressure of 15 kilos/cm.^{2}. G. D. H.

1257.* Deposit of Bentonite in Mendoza. Decree. Anon. *Bol. Inform. Petroleras*, June 1939, XVI (178), 36.—Decree of 6th May, 1939, granting a concession to the Y.P.F. to work a bentonite deposit in Potrerillos (Lujan). H. I. L.

1258.* The Celluloses in Algæ. G. Viel. *Ann. Off. Combust. liq.*, May 1939, **14**, 531–550.—The findings of the previous investigations of the constituents of algæ are briefly summarized. In the new work cellulose from *Fucus vesiculosus*, *F. serratus*, *Laminaria saccharina*, and *L. cloustoni* was examined. The method of preparation, the properties, and the proportions of the cellulose in these algæ are described. These celluloses are cellular, and in some cases fibrous. On hydrolysis they gave quantities of glucose of the order which should be given by celluloses.

These celluloses were heated to 1000° C. in 100° C. stages, 15 min. being allowed at each stage and 1 hr. at the final temperature. The volumes of gas evolved per gram have been plotted for the temperature stages, and the residual coke and heavy products were weighed. The curves obtained resemble those for vegetable celluloses. There is a maximum in the range 200–400° C., and a less prominent maximum at 700° C. Carbon dioxide and carbon monoxide were evolved most abundantly at 300–400° C., whilst methane appeared mainly at 500° C., except in the case of *Fucus serratus*, which has a maximum at 600° C. Hydrogen was evolved most strongly at 700° C.

G. D. H.

Geophysics.

1259.* Hydrological Exploration in Octyabrneft Fields. V. P. Yakovlev. *Neft. Khoz.*, March 1939, **20** (3), 25–30.—A report is given on work carried out to confirm the assertion that micro-oscillations of fluid levels in abandoned and temporarily shut-down wells are of exceptional importance, providing much information on capacity, etc., of the strata under exploitation which is otherwise impossible to obtain.

By the method indicated, numerous data have been obtained on the reservoir under examination which enable all necessary forecasts to be made on its future behaviour under all possible conditions, beginning with changes in hydraulic pressure owing to additional drilling of any number of wells, to the height of microstatic and dynamic levels in the oil wells of the reservoir under any rate of withdrawal and for any number of wells given.

From another, considerably larger, reservoir much less data were obtained.

The difference between the present method and those indicated by Hurst and Muskat is that the latter base their conclusions on information, obtained by other means, on the geological formation of the Woodbine layer, to determine its hydrodynamic properties, whilst in the method described, from the hydrodynamic manifestations of the sub-surface system information is obtained not only regarding its capacity, resistance, and other hydrodynamic properties, but also regarding the geological structure of the reservoir. L. R.

1260.* Electrical Measurements in Bore-holes. C. E. Ripamonte. *Bol. Inform. Petroleras*, June 1939, XVI (178), 56–59.—Examination of the nature of the substrata surrounding the bore-hole is done electrically; the measurements that are most commonly made are those showing the specific resistance and those indicating the permeability of the soil at the measuring point. Various bridge circuits are described for use with direct current, and reference is also made to others for use with alternating current. H. I. L.

Drilling.

1261.* Unitized Portable Skid for Boiler-Feed Pumps. Anon. *Oil Wkly.*, 5.6.39, **93** (13), 50.—A description is given of a simplified skid for boiler-feed pumps which requires only a few minutes to break the joint and winch the whole unit on a truck for transportation to another location. This type of assembly is rapidly replacing the older units at all boiler batteries in Santa Fe Springs, Monte Bello, and in other fields where there are company-owned drilling tools. A. H. N.

1262.* Throw Away a Few Feet of Rope and Save Several Hundred. Anon. *Oil Wkly.*, 26.6.39, **94** (3), 30.—A discussion on safely handling rope to yield maximum working life and efficiency. A. H. N.

1263.* Number of 10,000-ft. Tests Increasing Rapidly. W. L. Baker. *Oil Wkly*, 31.7.39, **94** (8), 59.—An interesting compilation of record-breaking depth tests is presented in this paper, which is one of a series of articles dealing with deep drilling published in this issue of the *Oil Weekly*. The paper is followed immediately by a second on the same lines. A. H. N.

1264.* Improved Practices Permit High-Speed Deep Drilling. B. Mills. *Oil Wkly*, 31.7.39, **94** (8) 66.—This is the third paper in the series of articles dealing with deep drilling published in this issue of the *Oil Wkly*. The record for deep drilling has been nearly doubled in the last 12 years. In 1927 the deepest penetration was 8046 ft.; to-day it is 15,004 ft. The ability to reach such depths is indicative of the vast improvements in technique and equipment.

The speed of drilling is particularly noteworthy, the speeds of to-day being about three times those of but a short time ago. Higher rotating speeds, and increase in weight on bit, the use of long and heavy collars to control the weight on the bit, accurate and constant mud control and controlled vertical drilling, and the adaptation of high steam pressures are all contributory factors which are analysed in detail by the author. Typical practices in various fields are given. A. H. N.

1265.* New Cementing Problems Created by Deep Drilling being Overcome Rapidly. B. Mills. *Oil Wkly*, 31.7.39, **94** (8), 110.—The conclusion of this detailed discussion on new cementing problems encountered in deep wells may be summarized as follows:—

(1) Regardless of the safety factor provided by equipment and materials used on the job, every possible hazard that can be anticipated should be eliminated with as little delay as possible.

(2) The well bore should be conditioned properly to receive casing and provide space for satisfactory volume of cement back of the casing.

(3) The rotary mud should receive constant attention during the entire period of casing and cementation. The viscosity should be maintained as low as is consistent with the necessary density.

(4) The cement used should remain pumpable well beyond the time allotted for pumping it in place. Anything may happen to upset the time-estimate.

(5) Cement and equipment should be selected on the basis of quality and adaptability to conditions.

(6) From 50 to 100% more cement should be used than the amount shown by calculation. A. H. N.

1266.* Deeper Drilling Requires Closer Mud Control. H. H. Farnham. *Oil Wkly*, 31.7.39, **94** (8), 126.—Inherent with drilling to greater depths, two factors are encountered which make it vitally essential that closer attention be given to the control of the properties of mud than is necessary in shallower wells:

(1) High temperatures are encountered, which may be between 200° F. and 240° F.
(2) The higher hydrostatic head of the mud means loss of mud at a fast rate when low-pressure, high-permeability sands are encountered.

These two factors are discussed, together with high-pressure filtration test apparatus, and typical examples of mud conditions in various fields in U.S.A. utilizing deep drilling equipment and methods are cited. Details are given of weights, viscosities, filtrates, cake thicknesses, and salt contents of the typical muds, together with methods of attaining these results. A. H. N.

1267.* Closer Determination of Pressures Would Help in Deep Operations. Anon. *Oil Wkly*, 31.7.39, **94** (8), 78.—Pressures maintain a fairly true rate of increase down to about 7500 ft., but below that level variations become more frequent and pronounced, thereby accentuating the hazard of blowouts on deep drilling. The paper deals with normal high pressures and freakish conditions encountered in deep drilling. A. H. N.

1268.* Relation of Preserved Wood to Deep Marine Operations. R. S. Manley. *Oil Wkly*, 14.8.39, **94** (10), 22.—The treatment of wood intended for derrick foundations in marine oil-well drilling is discussed. In locations off the coast in salt water the usual American practice is to have the timbers impregnated with at least 20 lb. of creosote per cubic foot if they are to be immersed in the water, and with 12 lb. per cubic foot if not actually submerged. For fresh-water locations in marshes or lakes, where the water becomes only slightly brackish part of the time, 16 lb. per cubic foot of wood for submerged timbers and 12 lb. if not submerged are considered to furnish ample protection. A. H. N.

1269.* Cement for Oil Wells. W. W. Robinson. *Oil Wkly*, 21.8.39, **94** (11), 20.—Paper presented before American Petroleum Institute.—The paper presents a compilation of test methods being used to evaluate cement for use in oil wells. These special procedures, which have been developed in the industry because standard test methods are not applicable, are given in detail, with purpose, procedure, interpretation, and practical application of test data. Results of tests covering several cements used in oil wells are shown. There is a definite need for standardization of methods for testing cements used in oil wells, and it is proposed that an American Petroleum Institute code be formed. In this, the first part of the paper, sampling, determination of standard slurry fluidity, and thickening-time tests are discussed. A. H. N.

1270.* Cement for Oil Wells. W. W. Robinson. *Oil Wkly*, 28.8.39, **94** (12), 18.—This is the second part of the paper presented by Mr. Robinson before the A.P.I. (*cf.* Abstract **1269**). The author details procedures for consistometry, tensile strength, Foam tests, and physical properties testing of cements for use in oil wells. A. H. N.

1271.* Results of Australian Drilling Discouraging. Anon. *Oil Wkly*, 21.8.39, **94** (11), 48.—Although the Federal and State governments of Australia are prone to do what they can to encourage prospecting for oil in that commonwealth, results at the end of 1938 were not very encouraging. Details of 38 wells are given in tabular form. A. H. N.

1272.* Enormous Assembly used on Gulf Coast Rig. N. Williams. *Oil Gas J.*, 22.6.39, **38** (6), 54.—Interest is shown in the production potentialities of the old Jefferson Island salt dome due to a deep test being drilled on the extreme north flank. For this test one of the largest, most modern, and most complete assemblies of drilling equipment on the Gulf coast is being used. The rig embodies a 10-in. draw-works—the

largest and newest size made. It has a 20½-in. high-speed oil-bath rotary driven by a separate 9 by 8 in. horizontal steam engine; two 20-in. mud pumps; an 18-in. mud-mixing pump with a desander and a degasser; a 990,000-lb. load, 136-ft. steel derrick with a 36-ft. base; a 700-000-lb. six-sheave travelling block, and a seven-sheave crown; four 130-h.p., 350-lb. working-pressure superheated boilers; a boiler feed-water installation, and two generators to supply lighting and power requirements.

A feature is the horizontal steam-rotary-drive engine mounted below the derrick floor to provide greater working space and room on the floor. The engine is hooked up not only to the rotary immediately above, but also to the coring reel and to the main draw-works, which can be run by the rotary engine in an emergency.

For the drilling hook-ups, provided to meet any emergency, two complete blow-out-preventer assemblies have been provided, mounted one above the other, with a 13¾-in. master gate-valve below each.

Other details are given about the mud system and the drilling programme.

A. H. N.

1273.* Survey of Drilling Equipment Reveals Economic and Operating Data. H. F. Simons. *Oil Gas J.*, 29.6.39, **38** (7), 34.—The data, obtained by means of a survey, based on thousands of questionnaires sent out to drilling contractors and drilling departments of oil companies all over the U.S.A., are summarized. Diagrams are given to illustrate the statistics. The paper deals mostly with the economics of drilling, but an interesting item is that the total number of rotary rigs was 47·2%, whilst cable-tool rigs accounted for 52·8% of the total number of rigs employed. Although no figures are available, it is almost certain that the greater share of footage is drilled by the rotary. More than half the rotary rigs use steam for the prime mover.

A. H. N.

1274.* Positive Vertical Drilling Cuts Costs and Saves Time. Anon. *Oil Gas J.*, 29.6.39, **38** (7), 40.—Positive vertical drilling is generally being accepted as beneficial, instead of being an addition to the cost of drilling. The factors to be studied are the conditions in the hole, the re-design of the drill stem, accurate determination of the deviation of the hole, and the selection of proper rotary speeds and weights on the bit. When rotary drilling in the Seminole field of Oklahoma yielded erratic results in the geological departments due to deviation of hole, acid-bottle tests were introduced, and it was shown that wells deviated by as much as 27°. For an average deviation of 5° the loss of footage on the 4400-ft. hole would be 16·72 ft.—enough to upset any geological map drawn on the information.

The costs chargeable to crooked holes come under two classes: direct and indirect. The items under each class are many and varied. Sometimes it is almost impossible to estimate the indirect costs due to crooked holes, such as increase in wear on drill pipe and breakoffs which have been accelerated by continuous bending and flexing, and increased difficulties in fishing jobs. Again, the bits are designed to yield maximum efficiency in a vertical hole, and hence will not be efficient in crooked holes. But no mathematical formula can give the loss in efficiency, as the factors involved are many and complex.

It is now accepted that a vertical hole is drilled as quickly and often quicker than a crooked hole, provided the proper equipment and technique are employed.

Two main factors affect the problem: geological conditions, and mechanical design and operation of the equipment. The former is unalterable, but, where adverse, can be circumvented by altering the second factor.

When the bit moves from a soft to a hard formation in an inclined structure it tends to move down dip, and vice versa. Rapid rotation and the application of as little weight as possible on the bit keep the hole vertical, but the time taken is prohibitive.

It is shown that so long as the drilling pipe is stable—*i.e.*, a vertical line passing through its centre of gravity falls within the base of the bit—the hole will be vertical. The C.G. of the pipe rises with increased weight on the bit. By increasing the weight of the drill collar, the centre of gravity is kept low and the ideal is approached. Some operators use 400-ft. drill collars. Addition of reamers or guides to centralize the collar in the hole confers further advantages.

Deviation tests should be taken continuously. Acid-bottle and ink-siphon inclino-

meters, together with chart-recording instruments of the sharp-pointed plumb bob and photographic types, are briefly described.

The readings should be taken often, and in a strange locality at every 100 ft. As long as the elements producing deviation are not severe, straightening is easily accomplished by removing weight from the bit and increasing the drilling speed of the table. Beyond a "critical angle" straightening becomes much more difficult. Plugging back may be resorted to, a whipstock may be run, or the bottom may be enlarged by a wall scraper to allow the collar to assume a vertical position. A. H. N.

1275.* **Low Cost of Drilling for Michigan Operators.** H. F. Simons. *Oil Gas J.*, 6.7.39, **38** (8), 12.—This is the second of two articles that discuss the present petroleum situation in Michigan. The geology and prospects of the fields are discussed in the first part of the paper.

Most of the drilling is done with cable tools, either standard rigs or spudding machines being used. There are only a few rotaries at work in the area, and these are used mostly for the drilling of drift and the Pennsylvanian formations. Using a rotary rig to drill the upper hole saves two strings of pipe in the fields where the Michigan stray is productive, as this formation must be sealed off. In the shallow fields three strings of pipe are run, 10 in. being driven through the drift and 8¼ in. used to shut off the cold-water formation. Either 5 3/16 or 6¼ is used for an oil string in most Michigan fields.

A producing well can be drilled to 1550 ft., cased, treated, and equipped with pumps, rods, and tubing for $7500; lift costs average 15 cents/brl. for the average recovery of 27,000 brl. for a 10-acre spaced well. A. H. N.

1276.* **Utilize New Type of Mud Circulating System.** N. Williams. *Oil Gas J.*, 13.7.39, **38** (9), 42.—A new mud system for drilling deep, high-pressure tests on the Gulf Coast gives (1) increased efficiency in mud-pump operation, (2) greater flexibility in conditioning and control of drilling fluid, with maximum protection against contamination, and (3) substantial savings in expenditure for mud and weighting materials. The new mud system embodies gravity flow of the drilling fluid to pump suction. The derrick floor has to be elevated to accommodate the greater height needed for the mud return line from the well to the ditch, with the advantage of increased clearance and working space under the floor, facilitating installation of the large drilling and blow-out preventer assemblies being used in the controlling of deep, high-pressure wells. A. H. N.

1277.* **Drilling-Time Data in Rotary Practice.** T. C. Hiestand. *Oil Gas J.*, 13.7.39, **38** (9), 55.—Drilling records have been used for some time, but the method has not been fully utilized until recently. Drilling-time data assist (1) in fuller recovery of cores, (2) in avoidance of undue loss of time in running on dull bits, and (3) permit the correction for sample lag, so that the log of the well checks with electrical and geothermal charts. The controlled drilling possible with modern rotary rigs, together with the use of the geolograph, making drilling-time records dependable for interpreting accurate depths of porous formations on the rig floor. This in turn allows the geologists, on drilling wells, to recommend appropriate testing of all zones where oil and gas occur. Six typical well cases are discussed. A. H. N.

1278.* **Drilling-Time Data in Rotary Practice.** P. B. Nicholls. *Oil Gas J.*, 20.7.39, **38** (10), 40.—Manual recording of drilling time has been used quite successfully, but the human element enters largely into the accuracy of the data. The information has been restricted chiefly to the depths where production is expected, and has not been kept for the majority of rotary operations. The paper describes the geolograph, an instrument which automatically records the rate of penetration, foot by foot, together with such related information as time out for repairs, round trips, etc. A diagram is given of the hook-up, and illustrates the manner in which the motion of the tools is recorded. Typical drilling changes in rates of penetration, together with information as to when the tools are on bottom, when drill-pipe connections are made, samples circulated, etc., are given in a typical chart. A. H. N.

1279.* Drilling Practice Committee. Anon. *Oil Gas J.*, 20.7.39, **38** (10), 50.—A report of the Drilling Practice Committee of the eastern division of the American Petroleum Institute is given. This report deals primarily with the costs and improvements in rotary and cable-tool drilling in the Illinois and West Virginian areas. A. H. N.

1280.* Complete 12,000-Foot Test in Louisiana Under Contract. N. Williams. *Oil Gas J.*, 3.8.39, **38** (12), 50.—The recent drilling on the Louisiana Gulf Coast of two wells under contract to 12,000 ft. reflects the greater confidence and certainty with which deeper exploration and development are being undertaken. Numerous tests have been drilled to that depth and to much lower levels, but these are the first instances in which a drilling contractor has assumed the risk attendant upon drilling to and completing a well at such a depth. The first well to be completed was the Gulf Refining Company's No. 1 Grandison in La Fourche Parish, coastal Louisiana. A description is given of the equipment used and operations in connection with the drilling of this test. A. H. N.

1281.* Skidding Derricks in the Permian Basin. D. H. Stormont. *Oil Gas J.*, 10.8.39, **38** (14), 44.—Where the topography is favourable and the distance is short, the moving of derricks to new sites is done more economically by skidding than by dismantling and re-erecting. Factors to be taken into account when derrick skidding is under consideration are discussed and current practices employed in skidding operations in the Permian basin of West Texas and New Mexico are described. A. H. N.

1282.* Directionally Drilled Wells Drain Oil from under Lake Centralia. H. F. Simons. *Oil Gas J.*, 31.8.39, **38** (16), 34.—By using modern methods of directional drilling, the formations under this Illinois lake are being effectively drained. A complicating factor met by the operators was the shallow depths of the wells, and the consequent high angles of deflection. It was feared that deflections of approximately 400 ft. might be not only economically prohibitive, but physically impossible to drill. For this reason it was decided to drill one of the longest deflections on the original attempt as a test job for the method.

The details and results of the drilling are given together with charts showing a horizontal and a vertical plan of the completed well. A. H. N.

1283.* Steel-Fabricated, Arc-Welded Field Slush Pump. W. C. Russell and L. W. Stahl. *Oil Gas J.*, 31.8.39, **38** (16), 40.—Deviating from the usual practices, the Emsco Derrick & Equipment Co. have developed a slush pump made up entirely of steel structural shapes and plates, steel forgings and castings welded together at the juncture of all parts. An exhaustive description, accompanied by many illustrations, is given of the many parts composing this mechanism and of the method of fabrication. A. H. N.

1284.* The First Horizontal Oil Well. L. Ranney. *Petrol. Eng.*, June 1939, **10** (9), 25.—A detailed account is given of the experiment conducted in horizontal drilling in a shallow oil sand. It is a description of the first horizontal oil well. A report is also given of a radial pattern of wells drilled horizontally from a central chamber in a property developed by the Ranney method. The manner and effects of shots are detailed and illustrated by graphs. A. H. N.

1285.* Californian Deep Drilling. W. A. Sawdon. *Petrol. Engr.*, July 1939, **10** (11), 27.—Greater advance has probably been made in the technique of high-speed rotation in drilling deep wells in the San Joaquin Valley, California, than in any other area in the world. Rotating speeds of 400 r.p.m. and greater have become more or less common in the Rio Bravo field, and a rotation speed of 600 r.p.m. has been employed in one operation in nearby territory. This speed was used mainly in testing, and only a small amount of hole was actually made at 600 r.p.m. A. H. N.

1286.* Heavy-Duty Drilling Equipment Required in Magnolia Field, Arkansas. H. L. Flood. *Petrol. Engr.*, Aug. 1939, **10** (12), 23.—Orderly development has resulted in 45 producers on 40-acre spacing. The author gives the early history of the field; details and justifications of the heavy equipment used; casing programmes and drilling speeds. The average depth of hole made per day is 190 ft. A. H. N.

1287.* Mud Analysis Used to Log Wells While Drilling. W. A. Sawdon. *Petrol. Engr*, Aug. 1939, **10** (12), 84.—Test equipment mounted compactly in a trailer is used to detect oil, gas, or salt water in formation being drilled. It also provides warning of wash-outs in advance of pipe failure. A. H. N.

1288.* Large Drilling Equipment Tested on Two Wells in California. W. A. Sawdon. *Petrol. Engr*, Aug. 1939, **10** (12), 95.—This long paper deals with the results of testing a heavy set of drilling equipment, which was designed for drilling 18,000–20,000 ft. depths, under rigid control to depths of 11,500 ft. in each of two holes. Full details are given. A. H. N.

1289. Merits of Zinc-Coating Threads of Drilling Pipe Joints. S. G. Znaichenko. *Azerb. neft. Khoz.*, December 1938, **18** (12), 29–30.—With increasing drilling depths, and consequently increased stresses, there is a rising tendency for the threads of drilling pipe joints to seize, resulting in reduced life of drill pipes. The effect of zinc-coating pipe threads to eliminate seizure has been examined.

It has been found that zinc-coating of drill-pipe joints remains effective even after prolonged service, whereas the graphite lubricant used heretofore always tended to be displaced or to harden and, consequently, could not efficiently prevent seizure or corrosion. In view of the low cost and ease of application, zinc-coating of the threaded pipe ends and pipe joints is strongly recommended. L. R.

1290. Cement with Hydraulic Admixtures for Oil-Well Cementing. N. A. Lutsenko. *Azerb. neft. Khoz.*, December 1938, **18** (12), 25–29.—Tests have been carried out with cement slurries containing varying proportions of "acid-hydraulic" admixtures (consisting mainly of silica and alumina).

The work has been divided into three parts: (1) examination of cement properties at normal and increased temperature, (2) effect of agitation on cement properties at normal temperature, and (3) determination of the temperature which develops during hardening.

It has been found that, in principle, Portland cement with acid-hydraulic admixtures may be used for cementing operations, giving great stability and resistance of the cement ring against the action of chemically active waters. To cement from the Kaspi factory 10% pumice stone may be added when used for shallow wells, for deep wells 20%. To cement of the Baku factory for shallow wells 15% pumice stone may be admixed, for deep wells 20% or more.

All types of cement examined, starting from the first hour of agitation of the slurry, decrease in physical strength with increasing intervals during which the slurry is in the dynamic state. The temperature developed during setting and hardening of cement containing pumice stone is sufficient for measuring electrothermically the height of cement reached in the space behind the casing. L. R.

1291. Prevention of Accidents in Drilling. V. Mussini. *Bol. Inform. Petroleras*, June 1939, XVI (178), 84–88.—Detailed description, with illustrations, of the points requiring attention in order to prevent accidents when carrying out work on the towers and drilling operations generally. H. I. L.

1292.* Transport of Fully Equipped Drilling Towers at Comodoro Rivadavia. H. Giraldez. *Bol. Inform. Petroleras*, June 1939, XVI (178), 45–52.—Illustrated description of movement of fully equipped drilling tower to a new emplacement. The tower was left in its normal vertical position and mounted on a skid of special construction. The relatively flat terrain made this possible. H. I. L.

1293. Transport of Heavy Weights at Comodoro Rivadavia. H. Giraldez. *Bol. Inform. Petroleras*, June 1939, XVI (178), 53–55.—Article illustrating the heavy weights that have to be transported whenever plant has to be set up at a fresh borehole in the field. H. I. L.

1294. Drilling Patents. M. Hokanson. U.S.P. 2,156,287, 2.5.39. Appl. 21.11.36. Drill bit with substantially circular cutting edges.

R. Cross and M. F. Cross. U.S.P. 2,156,333, 2.5.39. Appl. 6.3.37. A method for cleaning oil-well drilling fluids in which screens and a centrifugal pump are employed to eliminate all the cuttings and solid particles before recycling the mud.

R. L. Fluellen. U.S.P. 2,156,384, 2.5.39. Appl. 28.1.37. A slip for holding pipes.

J. A. Zublin. U.S.P. 2,156,444, 2.5.39. Appl. 29.8.38. Rotary reamer.

C. P. Walker. U.S.P. 2,156,519, 2.5.39. Appl. 7.9.37. Means for measuring the location of obstructions in wells by creating a pressure wave and recording the echoes.

A. C. Catland. U.S.P. 2,156,676, 2.5.39. Appl. 5.11.37. A rotary bit with cutters mounted on ball bearings.

R. E. Fulkerson. U.S.P. 2,156,939, 2.5.39. Appl. 29.3.37. A well packer.

M. Miller and L. N. Davis. U.S.P. 2,157,493, 9.5.39. Appl. 29.4.38. Well scraper.

R. R. Bloss. U.S.P. 2,157,728, 9.5.39. Appl. 22.11.37. Speed-up and speed-down for rotaries.

H. W. Buschman. U.S.P. 2,157,951, 9.5.39. Appl. 24.9.38. Well drilling cable control.

H. E. Grau and R. K. Hertel. U.S.P. 2,158,232, 16.5.39. Appl. 6.12.37. Drilling hook with ball bearing and spring elements.

J. J. McCann. U.S.P. 2,158,243, 16.5.39. Appl. 3.3.38. Casing cutter of the knife cutter type.

F. Kinzbach. U.S.P. 2,158,329, 16.5.39. Appl. 6.8.37. Whip stock for deflecting milling tools.

J. G. Dyer. U.S.P. 2,158,356, 16.5.39. Appl. 16.9.35. A drill pipe coupling means.

S. W. Long. U.S.P. 2,158,372 and 2,158,373, 16.5.39. Appl. 3.9.36. Spring hook.

C. H. Collett and A. R. Thompson. U.S.P. 2,158,406, 16.5.39. Appl. 17.5.37. Liner setter.

J. T. Ashcroft. U.S.P. 2,158,814, 16.5.39. Appl. 24.1.38. A fishing tool for drill stems. A. H. N.

Production.

1295.* Application of Vacuum to Pumping Wells. W. A. Sawdon. *Petrol. Engr*, June 1939, **10** (9), 31.—One benefit resulting from the use of high vacuum in pumping wells in several fields of California has been an increase in the gasoline content of the gas produced. Some operators believe vacuum operation results in increased oil production also. Others, whose records show no increase of production, realize the necessity of protecting their production by applying a vacuum as high as that used on adjacent wells.

The extremely close spacing of wells in the area has a definite influence on the amount of vacuum carried. The need to apply equal vacuum to neighbouring wells to effect a so-called "protection" was demonstrated when one well was put under atmospheric pressure to allow a clear-out. No fluid was found at the bottom of the well.

The functioning of vacuum pumps is given. A. H. N.

1296.* Production Methods in the Rodessa Field (Part 2 concluded). T. H. Gibbs. *Petrol. Engr*, June, 1939, **10** (9) 35.—It is estimated that 30% of the wells in the field produce by artificial lift. Of this number 85% produce by gas-lift and 15% by pumping. The latest type of gas-lift to receive wide acceptance in the field is the one known as the surface-controlled wire-line-operated type, which is described in detail in the paper. It is an intermitted gas-lift system where the operating valve is worked from the surface at regular intervals by means of a gas-turbine-driven wire-line hoist.

Pumping units and rigs are described in brief, and they present no unusual features. Sucker-rod troubles have not been excessive, and in the choice of rods the properties sought are great shock and fatigue resistance, ductility, toughness, and resistance to corrosion.

While hydraulic pumping is still in its experimental stage in this field, due to excessive corrosiveness of the water, two installations have already proved successful. A description of a hydraulic unit is given. It consists, in brief, of a pump-and-engine unit that is lowered in the well and a hydraulic power unit that is run from the surface. Clean oil pumped to the hydraulic engine actuates the pump.

Emulsion treatment is an easy task in the Rodessa field. The most popular methods are settling-tanks and heat, settling-tanks and chemical without heat, and chemical treatment without the use of heat or settling-tank.

Many attempts have been made to exclude bottom water or edge water, without appreciable success. Squeeze jobs have been satisfactory only in few wells—laboratory tests have shown that changes in volume as great as 30% can result from squeezing water from the cement into the low-permeability limestone formation, and thus misleading the operators as to the success of the operation.

Acidizing has been of great value to the field. It is used also in workover and clean-out operations. A departure from the customary two-pump oil-flush acidizing procedure is the use of gas to force the acid into the formation, thus preventing killing the well.

The paper also discusses plug-back operations, gun perforating, salt-water disposal, and the use of vacuum traps or blow-cases to lower separator pressure, with consequent increase in gasoline recovery. A. H. N.

1297.* Economic Study of Electric Power in Oil-Well and Pipe-Line Pumping Service. W. H. Stueve. *Petrol. Engr*, June 1939, **10** (9), 89.—Past performance records of oil-producing and pipe-line companies proved valuable in determining the merit of generating electric-power by the consumer, or of purchasing it for operations in oil pumping. In the choice of the electric-power source for oil-well pumping several factors must be considered. Some of the more important variables may be enumerated as follows :—

(*a*) Size and characteristics of the contemplated load.
(*b*) Nature and amount of fuel available and its cost or value.
(*c*) Possibility of water encroachment in the producing horizon.
(*d*) Probable decline of production in the specific oil-field.

These considerations are made in the paper, and a detailed study is also given of actual cases to illustrate the various points. A. H. N.

1298.* Electric Power Plays Important Rôle in Water Flooding of Nowata Field. J. D. Robertson. *Petrol. Engr*, June 1939, **10** (9), 109.—Of the 5200 acres under water-flood in Nowata field, Oklahoma, 3500 acres are being produced with the aid of electric power. The many problems arising in the various stages of water-flooding

operations are discussed. Tests are detailed, and the results are given in tabular and graphical forms. These should be helpful to operators planning a new project.
A. H. N.

1299.* Purchased Electric Power Section Symposium. J. E. Elliott and others. *Petrol. Engr*, June 1939, **10** (9), 131–140.—Three papers in this section deal with the application of electric power in oil-fields. The first, by J. E. Elliott, deals with East Texas and Rodessa Fields, and shows that proration of production has prompted combination billing for scattered meters and that demand rate permits low unit cost on high load factor. The second, by K. C. Johnson, deals with operations in Arkansas, where a total of 10,000 h.p. is distributed in oil-well and pipe-line pumping and refinery operations. The third, by N. W. Beaudreau, deals with South-west Texas oil-well pumping utilizing electric power which proves its worth in pumping wells situated in remote territory, where minimum attention permits pumpers to cover wide areas.
A. H. N.

1300.* Fundamental Considerations of Recycling in Condensate Production. E. Kaye. *Petrol. Engr*, Aug. 1939, **10** (12), 29.—In 1938, out of 111 new pools discovered in Texas, 27 were of the gas-distillate type. Careful consideration of all factors involved in recycling in such pools should safeguard against uneconomical installations. Such considerations are made in the paper dealing with the objectives and requisites of recyclings and with various recovery processes. The paper ends with a discussion of future developments.
A. H. N.

1301.* Hot-Water Heater for Preventing Freeze-Offs of Large-Volume Gas Wells. R. W. Parker. *Petrol. Engr*, Aug. 1939, **10** (12), 109–110.—A plan of the layout, and description of an installation in Cement Field, Oklahoma, is given. It is claimed that fire hazard that accompanies open-flame burning is thereby eliminated.
A. H. N.

1302.* Effect of Design and Direction of Rotation on Peak Torque of Pumping Unit. K. N. Mills and E. A. Olsovsky. *Petrol. Engr*, Aug. 1939, **10** (12), 113.—Torque capacity of a specific unit will vary with the direction of rotation, therefore both values should be known. This paper, which deals with torque and direction of rotation, is amply illustrated with figures, graphs, and tables to indicate how the geometry of a pumping unit, together with its direction of rotation, control the magnitude of the peak torque imposed on the reducer. It is argued that each unit should carry a torque factor on its name-plate, which would enable the user to determine the true torque capacity of the unit assembly when the crank rotates in either direction. A. H. N.

1303.* West Montebello Oil-field. H. M. Preston and V. L. King. *Petrol. World* (L.A.), Sept. 1939, **36** (9), 19–25.—The authors give the location and history, the operating conditions, and completion practice of the West Montebello field. A map and a section of the field illustrate the stratography and the five oil zones which form the productive regions up to date. The productivity of the five zones increases downward, the lowest being the most extensive. The present daily potential of the field is 40,000 brl.
A. H. N.

1304.* New Reserves in San Joaquin Valley. Anon. *Petrol. World* (L.A.), Sept. 1939, **36** (9), 28.—Gulf Oil Company's discovery of a second oil-field and new extensions to the existing fields will provide California with large additional supplies of crude oil for the future. The paper is a report on the new reserves at various localities in the new fields.
A. H. N.

1305.* Acid-soluble Liners for Oil-wells. Anon. *Petrol. World*, Sept. 1939, **36** (9), 68.—A new magnesium alloy pipe is being used as a removable liner by setting it as a section of casing and then removing it with the aid of inhibited hydrochloric acid. A wide variety of uses is described.
A. H. N.

1306.* Operating Practices Reduce Smackover Lift Costs. B. Mills. *Oil Wkly*, 12.6.39, **94** (1), 13.—Four types of wells exist in the Smackover field. The first pumps 50 brl. of oil and from a trace to a few barrels of water. The second pumps 25 brl. of oil and 100 brl. of water. The third pumps 25 brl. of oil and 500 brl. of water. The fourth pumps 10 brl. of oil and 1000 brl. of water. The average production of the field is 17,000 brl. of oil and 500,000 brl. of water daily. The present hard fight which faces the producers is directly due to poor drilling and production practices of 10 and 15 years ago. Hundreds of wells were drilled in a haphazard manner, blow-outs were numerous, over-production of large wells was rampant, and poor logs were in most cases worse than none.

The present oil reserve at Smackover is estimated at 60,000,000 brl., and attempts are being made to reduce lifting costs, the improvement being effected in equipment and methods where the greatest troubles arise rather than in a radical departure from former operating practices.

A travelling valve with a combination of cups and rings has been used to advantage in several wells. The composition rings are placed on the bottom of the valve and the cups on top. The rings are pre-swelled in oil, on the surface.

Troubles from sucker-rod failures above the 1000-ft. level have been traced to overloading, and the present practice is to use about 1000 ft. of $\frac{7}{8}$-in. sucker rods on top and from 1300 to 1600 ft. of $\frac{3}{4}$-in. rods on the bottom. The trouble is solved by following this practice and keeping a continuous check on handling the tubings properly and seeing that the threads are free from pits and imperfections.

"Pounding" in wells on the downstroke of the pump has been virtually eliminated by the installation of relief valves, which allow air into the lead lines on each stroke of the pump.

Constant studies of loads, strokes, vacuum requirements, submergence, reconditioning of wells, and equipment selection is helping in a hard fight to reduce costs. Corrosion trouble with sucker rods is severe, but it has been found that such troubles are particularly great with overloaded rods. Minor nicks and imperfections in rods which are working under conditions conducive to fatigue have often caused failures. Substitution of proper size for the rods and constant examination have eliminated the greater part of the troubles.

Alloy rods give better service.

Loose sand troubles have been reduced considerably by a study of fluid conditions, regulation of stroke, and the use of proper pumps. A. H. N.

1307.* Exception to Rule 37 (Relating to Oil-well Spacing). I. I. Gardescu. *Oil Wkly*, 12.6.39, **94** (1), 32.—The paper deals specifically with conditions in the East Texas fields, but is of general interest, in that a discussion is given of the merits and demerits of close spacing. It is shown that too close spacing is inefficient due to:

(1) too rapid lowering of reservoir pressure;

(2) the claim of close-spacing advocates that energy is wasted in friction in long journeys of oil is not valid, as the rates of flow are extremely small beyond the immediate vicinity of the well;

(3) water by-pass is more severe in close spacing, as there is a smaller pressure differential in the reservoir, since the average pressure difference between reservoir and producing well is distributed over larger areas, in the case of wide spacing within economic limits;

(4) the danger of water contamination from upper sands is greater the greater the density of wells per unit area.

These remarks apply particularly to fields—such as those of East Texas—where evidence is forthcoming against the existence of lenticularity of the sands.

A. H. N.

1308.* Consistent Records Vital to Efficient Pumping. F. B. Taylor. *Oil Wkly*, 19.6.39, **94** (2), 16–22.—Properly kept records form means for an unbiased analysis of conditions and troubles that often lead to corrective measures. With this theme as his thesis, the author discusses the value of records, and urges the keeping of complete yet concise records which not only tell the facts about changes and alterations, but also

record the circumstances and causes which necessitated the changeover. Sample sheets and forms are presented for well-repair cost record, well-repair job sheet, daily well-trouble report, well-inventory report, summary of well expenses, service record-data sheet, equipment and operating report, shop reports, sucker-rod record, flat-belt service record, and " V "-belt service record. A. H. N.

1309.* Aplication of Radial Flow Calculations to Gas Recycling Problems. L. S. Reid. *Oil Wkly*, 26.6.39, **94** (3), 17.—Because injection wells are considered " necessary evils," the ratio of producing to injection wells is kept from 2 to 4 with the latter working at full capacity. Muskat's analysis, which shows how the productivity of a formation can be calculated through the analysis of the rate of the pressure rise in a well which has been shut in for a certain period of time, is taken as a basis for this study. The hypothesis that the production rate is proportional to difference between the static and flowing bottom-hole pressure is accepted, and a formula is obtained defining this relationship in terms of pressures (P and P_e), thickness (b), and permeability (k) of the rock, and viscosity (μ) of fluid and the ratio of the radius of the well (r_w) and an external radius (r_e), where the pressure is equal to the reservoir pressure (P_e). The formula is—for radial flow

$$Q = \left[\left(\frac{2\pi kb}{\mu}\right) \Big/ \log_e\left(\frac{V_e}{V_w}\right)\right](P_e - P)$$

where P is the bottom-hole pressure of the flowing well.

The method of measuring bottom-hole pressure advocated in a gas well is to measure the casing-head pressure and calculate the bottom-hole pressure by adding the hydrostatic head of fluid filling the well. Thus a column of gas in an 8000-ft.-deep well under a surface pressure of 3,500 lb./sq. in. (gauge) and 125° F. with a molecular weight of 25 and a deviation factor of 0·8 is taken as an example and the bottom-hole pressure is calculated at 4625 lb./sq. in. absolute by utilizing the formula $\int V dp = \int \frac{RT}{P}\, dp =$ 8000 ft. of fluid. If the well was flowing so that surface pressure was 3000 lb./sq. in. the bottom-hole pressure would be 3970 lb./sq. in. absolute or a drop of only 155 lb./sq. in. in the hydrostatic head. In view of the relatively small drop in the hydrostatic head, it is believed that build-up curves can be used satisfactorily in estimating the pressure required for the injection of gas back into the reservoir.

Examples are also worked out to calculate the permeability of a sandstone and a limestone formation from a graph of pressure rise in casing for a well in the formation, using Muskat's formula for radial flow of gas in porous media.

Pressure differential between input and output wells and well patterns are discussed. The point of injection, with regard to the flanks or top of structure, is important. Consensus of opinion tends to support the top of the structure, as there is less danger of the gas being near the edge-water. The practice of gas recycling has been so recently developed that the superiority of one spacing pattern over another has not been established by actual operation, as has been the case in water-flooding. A. H. N.

1310.* Light Pumping Foundations Frequent Sources of Trouble. F. B. Taylor. *Oil Wkly*, 26.6.39, **94** (3), 21.—Foundations for light-weight field equipment are too often the cause of trouble and lost production. Difficulties may reassert themselves several times. Maintenance of foundation is a field expense always kept as low as possible, and hence repairs are too frequently inadequate.

The solution is not in complete and costly repairs, but in building a foundation in the first place to satisfy both conditions of operation and of equipment.

The paper deals exclusively with light foundations, and treats the problem under two major types of foundations :

(1) foundation for jacks ;
(2) foundations for single power pumpers of small power.

Massive foundations used with unit pumpers or lifts exceeding 6 or 7 h.p. are explicitly excluded from the discussion.

Newer methods of foundation design take fuller account than older empirical methods of the direction of stress and pull, and lay the foundations with as much area exposed as bearing surface in the direction of power as is possible. A. H. N.

1311.* East Texas Expected to Go On Pump at Increased Rate. B. Mills. *Oil Wkly*, 17.7.39, **94** (6), 34.—The East Texas field at the present time is still predominantly a flowing field, even after producing 1,370,000,000 brl. of oil in 8¾ years, an amount that exceeds the life time-quantity recovered from any field with the exception of Baku. Eventually, however, it will undoubtedly become a very extensive pumping area. The question whether pumping equipment will have to be installed at a faster rate in the future than in the past is a matter of prime importance to operators in the field. Indications show that it will, as the flowing life of the field has already been much longer than was predicted at the time of its discovery. A. H. N.

1312.* Ramsey Proving Value of Unit Development of Small Pool. B. Altman. *Oil Wkly*, 31.7.39, **94** (8), 41.—An outline is given of the development of the Ramsay Pool, Payne County, Oklahoma. The area is an example of the benefits attending unit operations. Structurally the field is a small dome with deep dip in all directions. The structure was found by seismograph explorations, and the discovery well was brought in in January 1938. Production is from the Wilcox sand at 4730—4800 feet. Bottom-hole pressure of the discovery well was 2038 lb.; so far the decline in pressure has been negligible. No free gas exists in the reservoir. A brief description of the drilling and completing methods employed is given. A. H. N.

1313.* Wasson-Bennett Merging to Make Largest, Most Active Field in Permian Basin Area. H. H. King. *Oil Wkly*, 7.8.39, **94** (9), 20.—The development of, and current operations in the Wasson–Bennet district of Gaines–Yoakum counties, West Texas, are given, with an outline of the drilling and completing practices employed there. The Wasson field has a proved area of 34,000 acres, and the Bennet field one of 3000 acres. Ultimate crude recovery from the known producing horizon in the district will probably exceed 250,000,000 brl. Regulations of the Texas Railroad Commission permit a maximum gas–oil ratio at Bennett of 2000 cu. ft. of gas per barrel of oil, whilst at Wasson the top ratio is 5000 cu. ft. of gas per barrel. A. H. N.

1314.* Sound Economics Must Be Teamed with Science in Future Course of Oil. F. Phillips. *Oil Wkly*, 14.8.39, **94** (10), 13.—The author attacks the uneconomic practices employed in the recovery of petroleum in the United States, more especially the excessive and competitive drilling which has merely resulted in smaller financial return to the industry. He pleads strongly for the adoption of unitization in the exploitation of oil-fields and for wider well spacing. Examples are cited of the waste attendant upon over-drilling of oil-pools and of the benefits that have accrued in other areas where producers have followed a unit plan of development. Mr. Phillips thinks that unitization, wider well spacing, and similar ideas for recovering ultimately the greatest amount of oil at the lowest possible cost will soon be universally recognized and applied by the American petroleum industry. But the necessity for unitization is urgent. A. H. N.

1315.* Texas' First Water-Flooding Project Big Success. J. C. Albright. *Oil Wkly*, 21.8.39, **94** (11), 36.—The history of the water-flooding projects in Texas is given from early days up to the present. Earlier neglect of scientific principles are discussed with their resultant troubles. The methods of conditioning and injecting the water to-day are given in detail, with a plan of the water-treatment plant for flooding oil sands on a typical field. The ratio of produced oil to injected water works out at 1 : 11. It appears that the flood has progressed to a point where the water has been distributed evenly over the lower portions of two sands. A. H. N.

1316.* Human Element in Pumping Efficiencies. F. B. Taylor. *Oil Wkly*, 28.8.39, **94** (12), 29.—A detailed discussion of the various human factors entering into the

efficiency of pumping wells is made according to the thesis of the author, " the engineer, the manufacturer, and the pumper must work together, or the best of equipment will be of little value." A. H. N.

1317.* Reaction to Draw-Down Methods of Potential Determination in Kansas Both Favourable and Adverse. W. H. Strang. *Oil Wkly*, 5.6.39, **93** (13), 31.—" Draw-down " refers to the reduction in height of the fluid column standing in the annular space. The footage difference in height of the fluid-level under static conditions and fluid-level height at a given rate of production is the draw-down for the rate of production. Productivity index is defined as production rate in brl./day per foot of draw-down, and when this factor is multiplied by the static fluid-level height, it will give a potential for the well.

Two types of instruments are described for measuring fluid levels by means of reflected pressure waves from the fluid level. Knowing the speed of the wave, and determining the time it takes to travel to or from the fluid-level, the height of the level may be assessed. When the wave travels from one gas into a denser one, the speed of the wave falls, and hence complications arise in wells which have stratified conditions of gas.

Other methods of tests are described, certain of them with particular reference to wells which do not produce free gas. Difficulties peculiar to certain wells, such as absence of markers in the well, in the form of tubing-catchers or liner-tops, are discussed.

It is shown that draw-down is proportional to rate of production by means of graphs.

The two other systems of determining potential, by pressure bomb method and 8-hr. production test, are described and discussed. A controversy rages around which method is the most accurate and fair. A. H. N.

1318.* Production Problems Contended With at Sac and Fox Pool. P. Reed. *Oil Gas. J.*, 1.6.39, **38** (3), 32.—The two chief troubles encountered in these areas are flooding on the surface and wax deposits. Detailed considerations are paid to the first problem, and provisions are made to work on raised levels in times of floods. To remove wax, lead lines are taken up every 90 days and brought to a boiler, where they are steamed out. Scrapers are sufficient in hot weather.

The history of the field is given. A. H. N.

1319.* Oklahoma City Field Enters Secondary Recovery Stage. H. F. Simons. *Oil Gas J.*, 6.7.39, **38** (8), 28.—Oklahoma City field is facing a prospective revival through the introduction of secondary recovery methods. In this paper, the first of a series of two articles, the author summarizes the present conditions and possible future of the Oklahoma City field.

A unique method of obtaining potential was instituted recently. An operators' committee, composed of engineers familiar with the field, arrived at estimates of what the potential would be if tested under periods of varying lengths. The estimates were well received, and it was decided to refine the work further and to arrive at a potential by sound engineering methods that would be agreeable to all parties.

The working of the scheme is summarized. A. H. N.

1320.* Acidization of Gas Wells in the Texas Panhandle. D. H. Stormont. *Oil Gas J.*, 6.7.39, **38** (8), 33.—The first gas well acidized in the Panhandle field was in 1937, and much progress has been made since then. Use of acid is now adopted as a standard completion practice by many operators in this field. Also many operators are treating some 10- or 12-year-old wells.

Treatment of gas wells, in general, is along the lines used in oil-well acidization, with the exception of some differences in the equipment used and the method employed. Stage treatment is now employed.

In acidizing oil wells oil is used as the loading to force the acid into the formation. In treating gas wells this is not possible, as there is a likelihood of the oil decreasing the permeability of the pay sand. Thus either compressed gas or water is used, with the former being more widely used since it is cheaper, more readily available,

and has been found to give better results. Also, water requires swabbing, which entails, generally, moving a swabbing machine to the well, and thus increasing the treating cost.

Use of addition agents designed to reduce the surface tension of the acid has greatly increased the efficiency of the methods used.

A detailed study of the many factors peculiar to the field and the work is given.

A. H. N.

1321.* Theories and Practices in Modern Oil-Well Shooting. R. B. Bossler. *Oil Gas J.*, 20.7.39, **38** (10), 34.—Considerable speculation as to the effects produced by the explosion still exist, although the purpose and effects of shooting oil-wells are well known. The author attempts to bring together some of the latest work on the subject, including his own field observations and deductions. The assumption that the creation of a cavity was the main object of shooting is now abandoned. Such assumptions give insufficient explanation of the results obtained. A. H. N.

1322.* World Crude Production. H. S. Norman. *Oil Gas J.*, 27.7.39, **38** (11), 56.—For the first six months of 1939 petroleum output of the world established a new half-yearly peak figure. Production amounted to over 1010 million brl., or nearly 33 million brl. above the output for the corresponding period of 1938. A. H. N.

1323.* Crude-Oil Reserves Increased in First Six Months. H. F. Simons. *Oil Gas J.*, 27.7.39, **38** (11), 62.—This is the *Oil and Gas Journal* half-yearly review of operations and developments in the United States petroleum industry. Discussing crude reserves, it is stated that new oil discovered in the first six months of 1939 amounted to roughly 1184 million brl. New pools promise nearly 240 million brl., and extensions to older fields account for the balance. The most important discovery of the period was the Magnolia field, Columbia County, Arkansas, which is credited with an ultimate recovery of 150 million brl. Deducting the production of 616½ million brl., the net gain in American crude-oil reserves during the first half of this year was 567½ million brl. A. H. N.

1324.* Major Areas Developed as Rice Country Pools are Extended. D. Dalrymple. *Oil Gas J.*, 3.8.39, **38** (12), 32.—One of the larger oil areas of the United States is the Rice County field, Kansas. It has a potential yield of nearly 1 million brl. of oil daily, and this potential promises to increase. New discoveries are tending to offset the natural decline in older pools. The early history of the field is outlined from 1924 up to recent developments. A. H. N.

1325.* East White Point Field, Texas. Anon. *Oil Gas J.*, 3.8.39, **38** (12), 37.—The East White Point field, San Patricio County, South-west Texas, is discussed thoroughly. The discovery well was completed in February 1938. There are 95 producing wells in the field. Production is obtained at about 5650 ft. All wells flow naturally: working pressures at the surface range from 500 to 1000 lb. on tubing and from 750 to 1200 lb. on casing. Bottom-hole pressure is 2500 lb. Gas/oil ratios in the field range from 500 to 600 cu. ft. of gas per barrel of oil. East White Point crude has a gravity of 39 degrees A.P.I., a gasoline content of 38%, and a gas oil content of 41·2%. Other data of interest are given. A. H. N.

1326.* Major Companies Control Bulk of Illinois Production. H. F. Simons. *Oil Gas J.*, 10.8.39, **38** (13), 31.—Salem, Louden, and Clay City constitute the main production areas in Illinois. They account for 199,000 brl. daily, or roughly eight-ninths of Illinois' total oil output at the time when the State was producing 225,000 brl. a day. Two-thirds of Illinois production is controlled by the major oil companies. The present leader in production, number of wells, and potential output is the Texas Corporation, and the second and third are the Carter Oil Co. and the Pure Oil Co., respectively. On 1st July last these three concerns alone had 1728 wells and a daily production of 109,900 brl. in Illinois. While the aggregate output of the larger companies is higher than that of the independent interests, the per-well yield of the major

companies is less than that of the independents. For instance, the average-per-well yield of the major interests in the Salem field at the end of June was 96 brl. per day, whereas the average of the small companies was 300 brl. per day. A. H. N.

1327.* Magnolia Field Columbia County, South Arkansas. Anon. *Oil Gas J.*, 17.8.39, **38** (14), 44.—A general account is given of the Magnolia field, Columbia County, South Arkansas. The field was discovered in February 1938. At present there are 50 producing wells in the field and the proven acreage amounts to 1750 acres. The original reservoir pressure was 3575 lb.; present pressure is 3358 lb. An analysis of the Magnolia crude is given. The field has an estimated ultimate recovery of 150 million brl. of crude. A. H. N.

1328.* Manifold Hookup on a Coastal Louisiana Production Property. N. Williams. *Oil Gas J.*, 31.8.39, **38** (16), 36.—A simplified, unusually flexible, and low-cost manifold has been developed by a Gulf Coast, Louisiana, oil producer and is described with respect to its construction and operation. A schematic chart is given. A. H. N.

1329.* Production Problems Loom for Shreveport Field. G. Weber. *Oil Gas J.*, 31.8.39, **38** (16), 47.—The Shreveport Field of Caddo Parish, North Louisiana, has entered its second year of development with a total of 48 wells and a daily average production in excess of 7000 brl. Although the pressure-production relationship in the field is discouraging at this time, conditions would have been much worse had not operators and State conservation engineers adopted sound conservation measures in developing it.

Tests in numerous wells show that the degree of permeability is much greater vertically than horizontally. This factor tends to retard lateral migration of oil to the well, favouring instead, vertical movement and eventual coning of the underlying water. Thus, it is indicated that in the future the field may enter a stage of more gradual pressure decline if production is controlled to prevent water intrusion at too early a date. A. H. N.

1330.* Production Patents. H. U. Garrett. U.S.P. 2,156,429, 2.5.39. Appl. 26.4.37. Bottom-hole control choke, consisting of a perforated casing and a tubing carrying two packers to be set above and below the gas sand, and thus form a pressure chamber.

C. C. Taylor. U.S.P. 2,156,709, 2.5.39. Appl. 20.4.36. A well cleaner and tester.

K. T. Penick. U.S.P. 2,157,496, 9.5.39. Appl. 16.12.35. Combined tubing head and braden head.

A. N. Porter. U.S.P. 2,157,628, 9.5.39. Appl. 11.1.37. An oil-well pumping rig.

J. P. Jackson. U.S.P. 2,157,704, 9.5.39. Appl. 9.10.35. A deep-well pump with two cylinders and pistons working simultaneously.

C. I. Leibensperger and F. H. Thorpe. U.S.P. 2,157,713, 9.5.39. Appl. 1.6.37. Process of manufacturing sucker-rod couplings and couplings so made.

W. L. Church. U.S.P. 2,157,729, 9.5.39. Appl. 17.5.37. Apparatus for bringing a well into production by gun perforation.

R. A. Mueller. U.S.P. 2,157,964, 9.5.39. Appl. 16.2.34. Tubing hanger in a casing-head provided with a stuffing-box so that the tubing may be reciprocated during the washing of the well.

H. E. Aulman. U.S.P. 2,158,393, 16.5.39. Appl. 2.4.38. A water-well casing.

L. Bowen. U.S.P. 2,158,569, 16.5.39. Appl. 24.5.38. A formation tester comprising a tail tube and a packer, the tube having a fine perforated test conduit and a pressure recorder responsive to pressures within the perforate extension and a relatively coarse-perforate member below the first member and out of communication therewith, and a pressure recorder responsive to pressures within said coarse-perforate member. A. H. N.

Transport and Storage

1331.* A Field Balance for Weighing Pipe to Determine Rate of Corrosion. T. H. Marshall and D. Chads. *Petr. Engr*, June 1939, **10** (9), 67–74.—It is pointed out that corrosion investigations carried out in the laboratory are not satisfactory, as field conditions cannot be reproduced. Corrosion experiments under field conditions have been made possible by the construction of a suitable balance. This balance consists of a supporting tripod, beam assembly, sample suspension sling, and a suspension device for the weights, and has a beam ratio of 5 : 1. It is easily portable, and strong enough to weigh a 10-ft. section of standard pipe weighing 30,000 gm. Tests have shown that the balance gives results to seven significant figures, as compared with six normally obtained with an analytical balance. A detailed description of the construction of the balance is supplemented by drawings. Results are vitiated by variation of air humidity. R. J. E.

1332.* Developments in Procedure for Installing Cathodic Protection to Pipe Lines. W. F. Rogers. *Petr. Engr*, Mid-Year 1939, **10** (10), 112–116.—The procedure adopted in the installation of cathodic protection is outlined. The recording of repairs to pipe-lines is recommended and a typical chart of cumulative rust-hole data is shown. From these data the future history of the pipe is predictable, so that the anticipated cost of repair can be compared with the cost of re-coating and applying cathodic protection. Alternatively, the application of cathodic protection alone may be considered.

Some field work is necessary to estimate the cost of cathodic protection. For a well-coated pipe a minimum potential of 0·80 volt is considered to give adequate protection. Measurements are made to determine the current required to maintain this potential, consideration being given to the effect of seasonal changes, and moisture content on the pipe, to soil potential and to the potential developed by the deposition of hydrogen on the pipe. The spread of current on the pipe is determined and data are obtained to show the length of pipe protected. Consideration is given to the spacing, composition, and resistance of the ground bed. From the data obtained the cost of cathodic protection is calculated. The use of engine-driven generators is recommended as the cheapest method of providing cathodic protection. R. J. E.

1333.* Method of Determining whether Electrical Protection should be Applied to a Pipe-line or the Line Reconditioned. D. B. Good. *Petr. Engr.*, July 1939, **10** (11), 29–30.—The application of cathodic protection is considered in relation to two different cases. First, where corrosion has already occurred, and secondly, where no corrosion is present but where damage would prove expensive and difficult to repair. In the first case it is assumed that a record of corrosion and maintenance costs of the pipe-line for a number of years is available. Preliminary resistivity measurements are made to determine the point at which the protecting unit is needed. Curves relating pipe to ground potential and current are then obtained and the amount of pipe protected by various currents is deduced. The voltage required is obtained from previous knowledge of the test ground or by soil resistivity measurements. Consideration is given to variations of pipe to ground potential with the seasons. From the data obtained the type of equipment necessary can be selected, the power consumption deduced, and the cost of electrical protection compared with the cost of reconditioning or maintenance. Where preliminary tests show that more than one unit is necessary, it is found that the length of pipe protected per unit is considerably greater than in a single unit operation, and simultaneous tests are made for comparing the cost of operation and installation with reconditioning or maintenance costs. In cases where only short lengths of pipe are affected, electrical protection shows to less advantage in comparison with reconditioning.

In the second case, measurement may indicate current losses and the adoption of electrical protection to be justified, although no corrosion has been observed. Moreover, even if no current losses are detected, high cost of reconditioning may justify cathodic protection as a precautionary measure. R. J. E.

Crude Petroleum.

1334.* Kulsara Crude. I. V. Vysotski. *Neft. Khoz.*, June 1939, **20** (6), 46–49.—Kulsara crude (from well No. 10) is a light, low-asphaltic crude oil with a high wax content. It is of paraffinic base and very rich in gasoline-ligroine fractions, 68·8% distilling below 300° C. (Engler).

The gasoline-ligroine fractions can be classified as follows: (*a*) aviation gasoline fractions, 29·2 and 39·3% distilling between I.B.P. and 130, or 160° C., respectively; (*b*) motor-car gasolines, 44·3 and 48·8% distilling between I.B.P. and 180° or 200° C. As the gasoline fractions, however, have a distinct paraffinic character, it is unlikely that high octane fuels could be obtained in the usual way.

23·5% of the crude distils between 200° and 300° C., and can be utilised for producing various grades of illuminating kerosine. Residual oil (28%) remaining after distilling off the light fractions (up to 300° C.) has an extremely low specific gravity ($d_{20}^{20} = 0·8606$) and a high pour point (+22° C.). After refining and dewaxing various high-grade residual oils can be obtained, including bright stock and aviation lubricating oils.

L. R.

1335.* Unusual Crude from Old Ocean Field, Brazoria County, Texas. Anon. *Petr. Engr*, July 1939, **10** (11), 62.—On analysis the crude was found to be lighter in colour than No. 1 N.P.A., low in sulphur, and yielded 71% of 200° C. E.P. gasoline and 14% of kerosine distillate, the remainder being graded as gas-oil. R. J. E.

Gas.

1336.* Progress in the Manufacture of Butane. J. W. Vaiden and F. E. Fisher. *Petr. Engr*, Mid-year **10** (10), 128–129.—Increased demand for propane and butane as a domestic and industrial fuel and the requirements of polymerization and synthetic processes have stimulated progress in their manufacture. A trend to higher quality has stimulated the construction of new plant for the efficient production of a high-purity product. Methods used to obtain the desired results are one or more of the following: high-pressure compression and absorption, refrigeration and vapour rectification. Changes in existing plant to give the desired results consist of higher pressures, increase in rate of absorption, lower oil temperature, refrigeration under high pressure, vapour rectification at low temperature, and liquid rectification at high pressure. The utilization of propane as a refrigerant, and also the construction of two modern plants, are described. Attention has been paid not only to processing plant, but also to the provision of efficient equipment for safe handling and storage of the hydrocarbons.

The increased importance of repressuring has focussed attention on the recovery of hydrocarbons from the gas before it is returned to the oil sands. R. J. E.

Cracking.

1337.* Houdry Process of Catalytic Cracking. M. Houdry. *Ass. franc. Tech. Petrol. Bull.*, 1.5.39 (49), 5–14.—A description is given, with flow-sheet and properties of the products, for a catalytic cracking process operating on typical crudes.

The crude first undergoes fractionation into straight-run spirit naphtha for reforming, and a fraction which, after separation of tar, forms the charge for the catalytic cracking unit. This operates under atmospheric pressure and at a moderate temperature. The cracked products are admitted to a fractionating column, the light products being separated into spirit and gas for reforming and polymerization. The high-boiling product is an excellent gas-oil, which may be cracked further if necessary.

When cracking crude or residual stock a vaporizer is interposed between the initial fractionating column and the catalyst chambers, the tar separator being by-passed.

A comparison is given of results on Lagunillas crude using two different vaporizers.

For Iraq crude a 61·5% conversion into 74·7 octane gasoline when operating on crude, and 76·5% on cracking stock, is obtained.

Using East Texas crude a 74·2% conversion into 74·4 octane gasoline is obtained when operating on crude, and an 80% conversion into 74·7 octane gasoline on cracking

stock. The process may readily be adapted to yield aviation spirit base of 79-8 octane number, having low sulphur and gum content.

Units are being constructed in France to come into operation in June 1939 on the basis of an annual output of 3½ million tons. W. S. S.

Refining and Refinery Plant.

1338.* Application of Automatic Controls. A. J. Foley. *Refiner*, 1939, **18** (8), 301.—Maintaining that the application of an automatic control instrument is of far greater importance than the instrument itself, the author cites several cases in the petroleum industry where the application of control had not the desired effect. These cases include thermal control of throughput on a combination unit, liquid level control of an absorber on a gasoline plant, liquid level control on the residue stream of a vacuum tower, and a pressure reducing regulator on a line between two distant gas-storage tanks. G. R. N.

1339.* Modern Instrumentation. D. J. Bergman. Refiner, 1939, **18** (8), 304.—Stability or smoothness of operation is the most desirable feature in automatic control systems for distillation, cracking, and polymerization plants. As a rule, flow control of feed is one of the major factors in obtaining process stability. In the simplest type of distillation unit automatic control is provided by flow control on the crude-oil charge, temperature control on the heater transfer line, control of the gasoline quality by means of tower top temperature with a valve in the line from the reflux receiver to the top bubble tray, and liquid level control at the bottom of the tower. In the conventional two-coil Dubbs unit fixed flow to the heaters is the heart of the control system. Transfer temperature is regulated by hand control using pressure-balanced valves in the gas lines to each heater. A pressure-control valve maintains constant pressure on the reaction chamber and a liquid level controller releases residuum from the bottom of the flash-chamber. Gasoline is controlled as in a distillation unit. Receiver gas is released by a pressure controller and metered, while receiver distillate passes via a flow controller to the stabilizer. The minimum instrumentation for a small U.O.P. catalytic polymerization unit is also described. It is essential that the maximum throttling range of the instruments be used in order to avoid hunting. Allowances must also be made for the tendencies of the equipment towards self-regulation. G. R. N.

1340.* Cooling Condenser Water with Spray Ponds. J. D. Watson. *Fuel Econ.*, 1939, **15**, 178–180.—When sufficient space is available around a works there is much to be said for handling the condenser water with a spray system. Normally the cost of installing such a system is less than for a natural-draught tower. Its cooling range is lower, but pumping costs are less. Providing the installation is correct, spray cooling can be as efficient as tower cooling.

Frequently the spray system has been condemned, when actually the installation of the system has been at fault. The ideal arrangement of the system and the types and setting of nozzles are outlined. T. C. G. T.

1341. The Cooling of Condenser Water. J. D. Watson. *Fuel Econ.*, 1939, **15**, 207–210.—A review of cooling towers, their types and construction, the Davenport, Foster Wheeler, and the louvred type manufactured by the Premier Cooler & Engineering Co. are described and illustrated with photographs and diagrams. T. C. G. T.

1342.* Flow Resistance of Viscous Fluids in Pipes. A. Skryabin. *Neft. Khoz.*, April–May, 1939, **20** (4–5), 67–68.—An equation is evolved for the flow resistance of two-phase liquids under laminary flow and non-isothermic conditions:

$$H = \left(\frac{128Q\eta_0 l}{\pi d^4 g 10^4} + \frac{16l\theta_0}{3gd10^4}\right)\left(\frac{l^{nC}-1}{nC}\right)$$

where H means pressure drop in m. water; Q throughput in cu.m./sec.; l pipe-length in m.; d diameter in m.; g acceleration of gravity in m./sec.^{2}; C heat capacity; η_0 viscosity in poises at the beginning of the pipe; θ_0 initial breakaway tension in dynes/sq. cm.; and n a constant = 3·5.

For highly viscous liquids without initial breakaway tension (*e.g.*, residual oil) the formula is simplified :

$$H = \frac{128Q\eta_0 l}{\pi d^4 g 10^4}\left(\frac{l^{nC}-1}{nC}\right)$$

L. R.

1343.* Analysis of Power Requirements in Refinery Operations. W. H. Stueve. *Petr. Engr*, June 1939, **10** (9), 120–128.—A comprehensive survey of the power requirements of U.S. oil refineries has been made from the point of view of the potentiality of oil-processing as a market for electric power sold by electric utility companies. Refineries are classified into : (*a*) skimming—gasoline recovery by distillation only, (*b*) skimming and cracking, and (*c*) complete, recovery of lubricating oil as well as skimming and cracking, and a detailed analysis of the power requirements of each class is given. It is concluded that a modern refinery uses 0·42 kw-hr. more electric power for every barrel of oil processed than an older type. A classification of refineries on a geographical basis shows the effect of location on the fuel used, *e.g.*, oil predominates in East Coast, coal in Appalachian, and natural gas in Arkansas refineries. The effect of new developments in the oil industry is illustrated by the possibility of the replacement of energy from refinery gases by purchased electric power as a result of the potential increase in the utilization of the gases in polymerization processes.

R. J. E.

1344.* Developments and Trends in the Natural Gasoline Industry. J. W. Vaiden and F. E. Fisher. *Petr. Engr*, (Mid-Year 1939), **10** (10), 44–48.—Developments of the natural gasoline industry are outlined and the effect on this industry of recent progress in the rest of the petroleum industry is discussed. Advancement of plant design is exemplified by the erection of refrigeration plants which are claimed to be more economic than conventional absorption or compression–absorption plants. Refrigeration has made possible efficient recovery of propane and butane at nominal pressure. Freezing difficulties experienced in refrigeration have resulted in intensive study of hydrate formation and the development of dehydrating processes. Progress has been made in the study of de-sulphurization to improve lead susceptibility. Better recovery of lower hydrocarbons by low-molecular-weight oils has resulted in the use of lighter oils for absorption. The application of repressuring has been attended by the development of high-pressure absorption, and operation at 1500 lb. has been successful.

The progress made by the refiner in the better utilization of his raw material tends to decrease the demand for natural gasoline, but increase in the octane rating of marketed gasoline makes possible an increased demand, owing to the good anti-knock value and lead susceptibility of natural gasoline. The synthetic processes of the refiner are open to the natural-gasoline manufacturer, and the adoption of dehydrogenation, polymerization, or alkylation would enable him to convert a low-price material into a high anti-knock premium product.

R. J. E.

1345.* Heater for Treating Cut Oil. J. C. Albright. *Petr. Engr*, July 1939, **10** (11), 64.—The production of cut oil from some wells in Oklahoma has resulted in the installation of small portable gas-fired heaters. These heaters are installed in the lead lines from the wells between the tubing head and the flow tanks, and may be set to deliver a constant temperature. A detailed description of the construction of a heater is accompanied by an illustration.

R. J. E.

1346.* Problems Arising from the Presence of Salts in Crude Oils. J. V. Canessa and M. Fernandez Romero. *Bol. Inform. Petroleras*, June 1939, XVI (178), 12–16.—The percentage of mineral salts present in crude petroleums varies greatly in different fields all over the world and also locally at different depths of the wells. The highest percentages are to be found in the Argentine, where an average taken from a number of samples shows as much as 2,226·5 gm. of sodium chloride per cubic metre. The article discusses the question generally and points out the serious damage which is caused to stills, fractionating stills, cracking towers, and condensers. The salts occur in the form of solution in water and as crystals surrounded by a skin of paraffin or asphalt.

The methods of dealing with these salts are indicated broadly, but another article in the same number treats the matter in fuller detail. There are four groups of treatment by physical processes and six different chemical methods of attacking this very serious trouble. References are given to recent literature on the subject. H. I. L.

1347.* Industrial Processes for Removing Salts from Crude Oils. B. Rikles and J. Stowasser. *Bol. Inform. Petroleras* XVI (178), 17–30.—This article contains a detailed account of the various processes employed which are most appropriate to the varying condition of the petroleums. These processes which have proved efficient, are

1. Electrical processes.
2. Decanting with application of heat and pressure.
3. Chemical processes.
4. Contact with solid materials followed by filtration.
5. Centrifuging.
6. Combination of electrical and chemical process.

An ample bibliography is added for reference. H. I. L.

1348.* Treatment of Petrols and its Chemical Aspects. A. F. Sainz. *Bol. Inform. Petroleras* June 1939 XVI (178), 31–36.—The article deals with treatment, (*a*) by absorbents, and (*b*) by chemicals. Various processes are detailed, and special mention is made of cracking which is accompanied by the production of sulphides, resins, etc., which have to be eliminated. H. I. L.

1349.* Y.P.F. Refineries—Improvements Installed in Record Time. Anon. *Bol. Inform. Petroleras*, June, 1939, XVI (178), 3–11.—Illustrated description of displacement of a cracking tower at a Y.P.F. refinery to a site at some distance and the installation of a new tower in its place. It is shown how the work was planned so as to secure minimum interruption in the working of the refinery. H. I. L.

Chemistry and Physics of Petroleum.

1350.* Thermal Dehydration of Ethane to Ethylene. L. Potolovskii and A. Atal 'Yan. *Petr. Engr*, July 1939, **10** (11), 40–48.—A comprehensive study of the pyrolysis of ethane over a temperature range of 675–900° C. with reaction periods ranging from 0·01 to 13 seconds is described. The investigation was directed towards determining the optimum conditions for the production of ethylene. At 675–850° C. for 0·3 to 0·6 sec. ethylene, methane, hydrogen, and hydrocarbons higher than C. 4 are formed. At higher temperatures acetylene is also produced. The maximum yield of ethylene from the ethane decomposed was obtained at 675–725° C., but a relatively small proportion of the ethane was decomposed. Above 850° C. the yield of methane, hydrogen, acetylene, and higher hydrocarbons increases rapidly. Pyrolysis at 875–900° C. for 0·05 sec. resulted in the decomposition of 85% of the ethane giving a 62% yield of ethylene. At 700–750° C. the greatest yield of ethylene was 40–45% in a reaction time of 2·9–7·0 secs. Increase of the reaction time reduced the amount of ethylene and increased the methane. It is concluded that the best conditions for the pyrolysis of ethane are preheating to 700° C. followed by instantaneous high-temperature pyrolysis in a tubular furnace of special steel capable of withstanding prolonged heating at high temperatures. R. J. E.

1351. Theory of Absolute Reaction Rates and The Polymerization of Ethylene. F. P. Jahn. *J. Amer. chem. Soc.*, 1939, **61**, 798–800.—This is a theoretical paper in which the activated complex method used by Eyring is employed to calculate the rate of homogeneous thermal polymerization of ethylene: by making simple assumptions concerning the entropy of activation rough agreement with experiment is obtained. R. D. S.

1352. Critical Constants of Ethane. J. A. Beattie, Gouq-Jen Su, and G. L. Simard. *J. Amer. chem. Soc.*, 1939, **61**, 924–925.—The authors have investigated the critical constants of ethane by the compressibility method and found them to be :—

$t_c = 32{\cdot}27 \pm 0{\cdot}01°$ (Int.),
$p_c = 48{\cdot}20 \pm 0{\cdot}02$ normal atmospheres,
$v_c = 0{\cdot}148$ litre per mole (4·93 cc. per gram),
$d_c = 6{\cdot}76$ moles per litre (0·203 gram per cc.)

The uncertainty in the critical volume and density is 1%. R. D. S.

1353. Compressibility of Gaseous Ethane in the High-Density Region. J. A. Beattie, Gouq-Jen Su, and G. L. Simard. *J. Amer. chem. Soc.*, 1939, **61**, 926–927.—The authors give compressibility measurements of ethane from 50 to 275° and from 5 to 10 moles per litre. R. D. S.

1354. Reactions of 3-Hexene. II. Condensations with Aromatic Hydrocarbons and Phenols. L. Spiegler and J. M. Tinker. *J. Amer. chem. Soc.*, 1939, **61**, 1002–1004.—3-Hexene has been condensed with hydrocarbons and phenols using a series of catalysers such as sulphuric acid, anhydrous hydrogen fluoride, dihydroxylfluoboric acid ($H_3BO_3F_2$), perchloric acid, zinc chloride, and aluminium chloride.

1, 2, or more hexyl groups were introduced into the aromatic nuclei to obtain the corresponding secondary hexyl derivatives. T. C. G. T.

1355. Hydrofluoric Acid as a Condensing Agent. II. Nuclear Alkylations in the Presence of Hydrofluoric Acid. W. S. Calcott, J. M. Tinker, and V. Weinmayr. *J. Amer. chem. Soc.*, 1939, **61**, 1010–1015.—It has been shown that hydrofluoric acid is an effective acid condensing agent for the preparation of nuclear alkylated isocyclic compounds.

It was possible to introduce into isocyclic compounds alkyl groups containing as few as two carbon atoms, but the best results were achieved when alkyl radicals containing three or more carbon atoms were used.

Olefines or compounds which under the conditions of reaction would be expected to react like olefines, such as alcohols, esters, ethers, or halides, were employed as alkylating agents. T. C. G. T.

1356. The Nitrogen Compounds in Petroleum Distillates. XIV. Isolation of 2 : 4-Dimethyl-8-Ethylquinoline from the Kerosene Distillate of Californian Petroleum. W. N. Axe. *J. Amer. chem. Soc.*, 1939, **61**, 1017–1019.—The isolation from a complex mixture of petroleum bases, of the hitherto unknown compound 2 : 4-dimethyl-8-ethylquinoline, is described. The structure of this compound has been established by oxidation to 2 : 4-dimethylquinoline-8-carboxylic acid and by synthesis of the compound. T. C. G. T.

1357. Simultaneous Dehydrogenation-Hydrogenation of *Cyclo*hexene in the Presence of Nickel. B. B. Corson and V. N. Ipatieff. *J. Amer. chem. Soc.*, 1939, **61**, 1056–1057.—In the presence of nickel, both at superatmospheric and at ordinary pressure, *cyclo*hexene is converted almost quantitatively into a mixture of *cyclo*hexane (68% by weight) and benzene (32% by weight).

This is in contradiction of earlier workers, whose results indicated that nickel was not such an effective catalyst. T. C. G. T.

1358. Isomerization of Akyl*cyclo*pentanes. H. Pines and V. N. Ipatieff. *J. Amer. chem. Soc.*, 1939, **61**, 1076–1077.—Alkylated *cyclo*pentanes have been isomerized to yield methylated *cyclo*hexanes. Thus at 50° C. in the presence of aluminium chloride ethyl*cyclo*pentane yielded methyl*cyclo*hexane; propyl- and isopropyl-*cyclo*pentane gave 1 : 3-dimethyl*cyclo*hexane, whilst *n*.-butyl-, *s*.-butyl-, and *t*.-butyl*cyclo*pentane yielded 1 : 3 : 5-trimethyl*cyclo*hexane.

The yield of isomerized product in most cases exceeded 80%. T. C. G. T.

1359. The Formation of Intermediate Compounds in Hydrocarbon Syntheses by the Friedel and Craft Reaction, and the Preparation of Certain Symmetrical Trialkylbenzenes. J. F. Norris and D. Rubinstein. *J. Amer. chem. Soc.*, 1939, **61**, 1163–1170.—The heavy oil that separates when a solution of aluminium chloride in toluene is treated with hydrogen bromide at room temperature has a composition approaching $Al_2Br_6,6C_6H_5CH_3$. When this oil is evaporated at room temperature at 10–11 mm. pressure, the non-volatile product appears to have the formula $Al_2Br_6,C_6H_5CH_3$.

The results of the determination of the molecular weight of the oil indicate that the latter, when dissolved, was converted into toluene and the complex $Al_2Br_6,C_6H_5CH_3$.

The ethylation of benzene with ethyl chloride and ethyl bromide when the molecular ratio of Al_2Cl_6 to C_6H_5 was 1 to 1 gave yields of *s.*-triethylbenzene from 85 to 90% of the theoretical. Excellent yields of *s.*-ethyldimethylbenzene and *s.*-diethylmethylbenzene were obtained.

Evidence was obtained that the molecular ratios of Al_2Cl_6 to hydrocarbon were the determining factor in the relative proportions on which the several alkylated products were formed.

At 0° the chief product of the methylation of benzene with 3 moles of halide is 1 : 2 : 4-trimethylbenzene, whilst at 100° it is 1 : 3 : 5-trimethylbenzene.

The rearrangement of *o.*-xylene and p.-xylene to a mixture of the three isomers was studied.

The influence of temperature on the structure of the xylenes formed when toluene is methylated showed that the low temperature favours the formation of the *ortho* and *para* compounds, whilst at 100 the chief product is the *meta* isomer. In ethylation the product was largely *meta* at the two temperatures.

Detailed directions are given for the preparation of the symmetrical tri-derivatives because the methods give much higher yields and purer products than have previously been obtained. T. C. G. T.

1360. Some 1 : 4-Diaryl-1 : 3-*cyclo*pentadienes. N. L. Drake and J. R. Adams, jun. *J. Amer. chem. Soc.*, 1939, **61**, 1326–1329.—A description of the preparation of three 1 : 4-diaryl-1 : 3-*cyclo*pentadienes by the condensation of methyl aryl ketones and β-arylpropionates in the presence of sodium ethoxide and of several derivatives of these dienes. T. C. G. T.

1361. Low Temperature Dehydrogenation of Hydroaromatic Rings. R. T. Arnold and J. C. Collins. *J. Amer. chem. Soc.*, 1939, **61**, 1407–1408.—A low temperature procedure for the dehydrogenation of hydroaromatic rings by chloranil is discussed and the advantage of this method over selenium dehydrogenation is pointed out. T. C. G. T.

1362. Rearrangement of 1 : 3-Dimethyl-4-*t.*-Butylbenzene with Aluminium Chloride. L. I. Smith and H. O. Perry. *J. Amer. chem. Soc.*, 1939, **61**, 1411–1412.—1 : 3-Dimethyl-4-*t.*-butylbenzene has been prepared and characterized. This hydrocarbon, when treated with aluminium chloride, rearranges into the 1 : 3 : 5-isomer, which is the only one of the isomers obtained from *m.*-xylene, *t.*-butyl chloride, and aluminium chloride.

In view of the orienting effects of the two methyl groups in *m.*-xylene, and the rearrangement described in the paper, it is suggested that in the Friedel-Crafts synthesis of 1 : 3-dimethyl-5-*t.*-butylbenzene, the *t.*-butyl group first enters the 4-position, giving the 1 : 3 : 4-isomer, which is then rapidly rearranged by the catalyst to the 1 : 3 : 5-compound. T. C. G. T.

1363. Condensation of Alcohols, Ethers, and Esters with Aromatic Hydrocarbons in the Presence of Aluminium Chloride. J. F. Norris and B. M. Sturgis. *J. Amer. chem. Soc.*, 1939, **61**, 1413–1417.—Toluene, ethylbenzene, *t.*-butylbenzene, and *t.*-butyl-*m.*-xylene-(1, 3, 5), have been prepared by the condensation of primary aliphatic alcohols with aromatic hydrocarbons by means of aluminium chloride.

Condensation of benzene, in the presence of $AlCl_3$, with other oxygen-containing compounds is also described. T. C. G. T.

1364. Addition of Halogen and Acetoxyl to Ethylene. F. C. Weber, G. F. Hennion, and R. R. Vogt. *J. Amer. chem. Soc.*, 1939, **61**, 1457–1458.—β-Chloroethyl acetate and ethylene dichloride are the chief products when ethylene is chlorinated in acetic acid, acetic anhydride, or methyl acetate. T. C. G. T.

1365. Addition of Hydrogen Halides to *cis*- and *trans*-2-Pentene. M. S. Kharasch, C. Walling, and F. Mayo. *J. Amer. chem. Soc.*, 1939, **61**, 1559–1564.—Various workers results upon the addition of hydrogen bromide to 2-pentene seem to indicate different ratios of products depending on the condition of addition and the source and previous treatment of the pentene employed.

cis- and *trans*-2-Pentenes have been prepared and the addition of HCl and HBr has been investigated. The ratio of product has been found to be independent of the conditions of addition and the isomer of 2-pentene employed. T. C. G. T.

1366. Hydrogen Fluoride as a Condensing Agent. VI. The Alkylation of Benzene with compounds containing an "Allylic" Group. J. H. Simons and S. Archer. *J. Amer. chem. Soc.*, 1939, **61**, 1521–1522.—Hydrogen fluoride has been used to obtain reaction between a number of "allylic" compounds and benzene. Allyl benzene and 1 : 2-diphenylpropane has been prepared from allyl alcohol and 1 : 2-diphenylpropane from allyl benzene. T. C. G. T.

1367.* Studies in Water-in-Oil Emulsions. Part II. The Interfacial and Surface Activities of Magnesium and Calcium Oleates and the Rôle Played by these Soaps in the Stabilization of Water-in-Oil Emulsions. R. C. Pink. *J. chem. Soc.*, April 1939, 619–621.—The author has measured by the drop-weight method the effect of the lowering of interfacial tension between benzene and water produced by magnesium and calcium oleates. The effect is very marked, but surface tension shows a slight increase. The author observes that with soaps of multivalent metals the reduced interfacial tension permits easy subdivision of the water in the oil, with consequently less tendency to separation, and that the film of hydrated soap precipitated at the interface prevents coalescence of the globules, some of which are simply entangled in the precipitated soap; the latter is much more readily wetted by oil than by water, which fact is apparently the type-determining factor. R. D. S.

1368.* Mechanism of Addition to Double Bonds. Part X. Kinetics of Association of *cyclo*Pentadiene. H. Kaufmann and A. Wassermann. *J. chem. Soc.*, May 1939, 870–871.—Continuing the investigations into the reaction $2C_5H_6 \rightleftharpoons C_{10}H_{12}$, the authors have measured the velocity coefficients in polar and non-polar solvents and in the gas phase. The velocity coefficients in these are all approximately the same, as are the activation energies and the kinetic A values. The latter are the products of the steric factors and the bimolecular collision numbers. Steric factors being assumed equal, the collision number in polar and non-polar solvents and in the gas phase is of the same order of magnitude. R. D. S.

1369.* Palladous Chloride as a Dehydrogenating Agent. G. W. Cooke and J. M. Gulland. *J. chem. Soc.*, May 1939, 872–873.—Attempts were made to dehydrogenate hydroaromatic and reduced heterocyclic compounds by means of palladous chloride with only fair results generally, but while the conclusion is that palladous chloride is unlikely to find general application as a dehydrogenating compound, in some cases it may perhaps prove more acceptable than selenium, especially where small quantities of material only are available. Examples are given in which palladous chloride oxidizes to carboxyl a methyl group attached to the benzene ring. R. D. S.

Analysis and Testing.

1370.* Physical and Chemical Properties of Petroleum Fractions. H. T. Rall and H. M. Smith. *Industr. Engng Chem. Anal.*, 1939, **11** (7), 387.—An apparatus is described which permits exact and rapid introduction of accurately weighed quantities

of viscous-oil samples into a cryoscopic molecular-weight apparatus by diluting the sample with a known quantity of solvent from the same source as used for the molecular-weight apparatus. The molecular weights of several test oils were determined; these included a kerosine, an aromatic oil, a bright stock, and an acetone extract of a lub. oil. A comparison of the results showed that the error caused by dilution will not exceed 2%. Data obtained in the determinations of the molecular weights of three highly viscous samples are given. G. R. N.

1371.* A Microviscometer. J. R. Bowman. *Industr. Engng Chem. Anal.*, 1939, **11** (7), 409.—The method employed in this microviscometer depends on the rate of fall under gravity of a short segment of liquid contained in a longer capillary. The tube is vertical, straight, and of uniform bore—a length of 25 cm. was found to be convenient. It bears three etched marks, two near the bottom and one near the top. A glass vapour jacket is sealed around the tube. Various refinements of the apparatus are described. The instrument gives better than 4% absolute accuracy and a precision within 0·1% in the range from 2 to 10,000 centistokes. The method is regarded as simple and rapid, and requires only one drop of the sample. G. R. N.

1372.* Laboratory Fractionating Column. G. F. Reyling. *Industr. Engng Chem. Anal.*, 1939, **11** (8), 419.—Small packed laboratory fractionating columns with constricted bases often tend to become filled with condensed liquid, which cannot return to the flask because of the pressure of the rising vapours. Consequently the column fills with liquid and fails to operate properly when near its maximum capacity. This condition may be alleviated by placing a glass tube, bent in the shape of an open hook, in the bottom of the column. This arrangement permits return of the condensed liquid to the flask, and at the same time allows the vapours to pass unhindered to the top of the column. G. R. N.

1373.* Greaseless High Vacuum Valve. R. H. Crist and F. R. Brown. *Industr. Engng Chem. Anal.*, 1939, **11** (7), 396.—A more rugged and compact modification of the Ramsperger valve is described. A metal diaphragm is used with silver chloride as the seating surface. The leak through this valve as measured by a McLeod gauge was generally less than 0·0001 mm. per hour. G. R. N.

1374.* Determination of Neutral Oil and Tar Acids in Phenolic Compounds. E. Field and L. Steuerwald. *Industr. Engng Chem. Anal.*, 1939, **11** (8), 426.—In the estimation of the neutral oil the sample is refluxed with 10% caustic soda in a described procedure. The insoluble material plus a small amount of the soda extract are suitably transferred to a Babcock bottle and centrifuged to give an accurate line of separation. Results show an accuracy of 0·1% on a variety of cresylic acids and on blends containing known amounts of neutral oil. After criticizing the U.S.D.A. method for estimating tar acids, the authors describe their "liberation" method, in which the sample is extracted with 20% caustic soda in the presence of petroleum ether. The tar acids are liberated by use of 25% sulphuric acid and are washed/recovered with the aid of sulphuric acid of specific gravity 1·5–1·51. The procedure, though lengthy, gives an accuracy of 0·2% as demonstrated by the results obtained. It is held that specifications formulated on the basis of these improved methods will represent quality which is at once rigid and dependable. G. R. N.

1375.* Solubility Characteristics of Tars and Pitches Produced by Coal Hydrogenation. M. L. Fein, A. Eisner, H. M. Cooper, and C. H. Fisher. *Industr. Engng Chem. Anal.*, 1939, **11** (8), 432.—The determination of the insoluble matter in hydro tars and pitches was studied according to the various physical principles involved and to the various methods recommended. The following procedure was finally adopted. About 10 gm. of sample are weighed into a 250-ml. centrifuge bottle and heated to about 90° C. Twenty volumes of 7% cresol-tetralin (previously heated to about 90° C.) are added slowly with manual stirring. The resulting mixture is stirred mechanically for approximately 3 min. and then centrifuged at about 2400 r.p.m. for about 20 min. The supernatant layer is decanted and 150–200 ml. of benzene at room temperature

are added. The solid residue is broken with a stirring rod, after which the mixture is stirred mechanically for about 3 min. and centrifuged. The layer of benzene is decanted, after which the bottle and residue are dried to constant weight at 110° C. (2–3 hr). 48 References. G. R. N.

1376.* Laboratory Ageing Tests for Lubricating Oils. F. Jostes and A. Hann. *Oel u. Kohle*, 1939, **15**, 515–518, 533–537.—The behaviour of a lubricating oil in one engine is so greatly dependent on the design of the engine and the fuel used, that it is very difficult to infer its behaviour in any other engine. Still more difficult is it to correlate laboratory ageing tests with actual performance in the engine. Laboratory methods not only show considerable differences in the fixed conditions (temperature, oxygen- or air-rate, catalysts, etc.) under which the ageing is carried out, but they also differ in that changes in different properties of the oil (asphalt or resin content, acidity, viscosity, etc.) are used as the measure of the degree of ageing. Further, even if one particular method is used, by observing the change in different properties, contradictory results for the stability may be obtained.

In the author's opinion, the difficulties arise from the fact that the oil is usually aged for a given time and the alteration in physical properties measured. He suggests that a much sounder method is to find the time taken to effect given alterations in these physical properties.

The Indiana oxidation test is based on this conception, as the reported figure is the time taken for the formation of 100 mg. asphalt/10 gm. oil. If the time is more than 50 hr., the viscosity is measured after 50, 100, 150, and 200 hr. oxidation. The author considers that the large volume of oil (300 ml.) used is cumbersome, and makes the withdrawal of truly representative samples difficult, and so suggests using 20 ml., and blowing at 650 ml./hour instead of 10 litres per hour. Comparative tests showed that the modified method gives results within the normal limits of error of the standard method, and the author used this modification of the method throughout his investigations.

In order to see if the invariants had an appreciable effect on the degree of oxidation, ten different lubricating oils were examined with the following results.

Influence of the Glass.—Oxidations were carried out in tubes of Duran, Jena glass, and Thuringrian glass; no appreciable difference was found, so all the remaining work was done with Jena-glass apparatus.

Influence of Temperature.—Oxidations were carried out at the standard temperature of 172° C., and at 200° and 240° C. The results show that, in general, the relative positions of the curves are unaltered by increase in temperature. A table is given showing the order of stability of the ten oils as indicated by the time taken to form 5, 10, and 15 mg. sludge/gm. oil at each of the three temperatures. This shows that the least reliable evidence is that given by the times of formation of 5 mg. sludge/gm. oil at the lowest temperatures. Accordingly the author suggests the further modification of the test in that the temperature of oxidation be raised to 200° C., and that the reported figure be the time taken to produce 15 mg. sludge per gm. oil.

Influence of the Air-rate.—The test was run at 172° C., with the air-rate 1000 ml./hour in place of 650 ml./hour. No important alteration in the grading of the oils was observed, the effect being the expected one of accelerated ageing.

Further oxidation experiments were carried out on (1) brown-coal paraffin wax; (2) Fischer paraffin wax; (3) octadecene; (4) oleic acid; (5) oleic alcohol; (6) synthetic oil; (7) Edeleanu extract from a light Roumanian machine oil, deasphalted with fuller's earth; (8) topped Wietz crude oil, deasphalted with propane, extracted with furfural, and twice treated with fuller's earth.

The first four gave no product insoluble in normal benzine after 100 hr. oxidation at 172° C. The neutralization value showed a large increase, especially in (1) and (3), indicating that the oxidation was mainly of hydrocarbon to carboxylic acid. (5) gave semi-solid products of which 37% was insoluble in normal benzine, but this residue was not asphaltic, consisting of other oxidation and polymerization products. (6) merely became viscous, giving no asphaltic precipitate with normal benzine. (7) had become a viscous tar after 48 hr.

It will be noticed that hydrocarbons, whether aliphatic, aromatic, or naphthenic, oxidize mainly to acids, whilst oils containing petroleum resins oxidize to asphaltic

matter. Further experiments showed that the addition of resins to (6) caused the treated oil to form asphalt on oxidation, whilst untreated no asphalt is produced. It seems therefore that the ageing properties of lubricating oils are, in general, dependent on the content of petroleum resin, and not on the composition of the hydrocarbon mixture. T. T. D.

1377.* Motor Methods of Testing Fuels and Lubricants. A. v. Philippovich. *Oel u. Kohle*, 1939, **15**, 551–556.—Agreeing with the necessity of engine tests for rating gasolines, the author considers the C.F.R. motor method lacking in several respects, criticizing the bouncing-pin method of recording knock and the fact that the determinations are carried out at only one mixture strength and at only one temperature. The advantage of the octane number lies chiefly in the world-wide use of the C.F.R. engine, and to retain this the author suggests that the present method of testing be extended to give results of greater usefulness.

To determine the instant at which knocking starts, the author stresses the necessity of an automatic indicator, preferably recording the second differential of the pressure with respect to time. He further suggests that the octane number should be determined with the mixture temperature at 86° F., 122° F., and 212° F., as well as at the standard temperature of 300° F., the mixture strength being as specified in the ordinary C.F.R. motor method. From these figures, diagrams can be drawn showing the variation of octane number with temperature. The author states that four types of diagram are obtained: (1) aromatic, (2) olefinic, (3) alcohol mixtures, (4) paraffinic. He therefore suggests that in reporting the octane number of a gasoline the appropriate suffix should be used, *e.g.*, O.N. 73_3, signifies that the fuel has an octane number of 73 and that its temperature variation is of the olefinic type.

Once these diagrams have been obtained, the octane number at any required temperature can be deduced from a measurement at any other temperature, provided the composition of the fuel is known. Further, a more genuine forecast of the behaviour of a fuel in an engine is possible, as the octane number at the running temperature is readily deducible.

The deficiencies in the motor method are implicitly admitted in many specifications for aviation gasolines which require more direct information regarding the behaviour of the fuel in the engine—*e.g.*, variation of mean effective pressure with excess air at different temperatures. The author considers that these methods give results of much more significance than the mere determination of the octane number.

Turning to the testing of lubricating oils, the author again prefers actual engine tests, and suggests that a useful method is to determine the time required for ring-sticking to occur in an engine run under fixed conditions at different temperatures. In this way the stability of oils at different temperatures is obtainable, and thus the most suitable oil for use in any particular engine the working temperature of which is known, can be deduced. T. T. D.

See also Abstracts Nos. 1378 and 1379.

Gas, Diesel and Fuel Oils.

1378.* Estimation of Ignition Qualities of Diesel Fuels in the Laboratory. G. Vorberg. *Oel u. Kohle*, 1939, **15**, 497–499.—The following methods are used to obtain indications as to the ignition properties of diesel fuels: (1) hydrogen content; (2) aniline point; (3) diesel index; (4) cetene number (by Marder's density method); (5) cetene or cetane number determined on either the I.G. or C.F.R. test-engine.

The object of this paper is to correlate the results obtained by the first four of these methods with the last, which is considered the only intrinsically reliable one. Tests were carried out on forty-two samples of widely differing origin, including oils obtained by the hydrogenation of coal, as well as of petroleum origin. The results show that all these methods give figures which correlate well with those obtained in the test-engines, except the first, and the author maintains that the hydrogen content is not a reliable guide to ignition properties. He suggests that methods (3) and (4) are very valuable for obtaining a rapid and reasonably accurate indication of these properties. T. T. D.

1379.* Simple Motor Method for Testing Diesel Fuels. H. Neumann. *Petrol. Z.*, 1939, **35**, (33), 614–621.—A new laboratory method for testing diesel fuels comprises the use of a very simple inertia indicator built into the injector needle of diesel engines for recording the ignition impulse and a receiving device connected with the crank-shaft. The resulting accuracy compares well with the precision obtainable in the timing of the valve gear of the engine itself, and the ignition lag and cetene number of the fuel are easily established. E. W. S.

Lubricants and Lubrication.

1380.* Trends in Lubricating Oil Manufacture. G. A. Fitzgerald. *Petr. Engr*, Mid-year 1939, **10** (10), 105–110.—The motor industry being the biggest market for lubricating oil, changes in engine design have had a big influence on the lubricating-oil industry. Closer clearances and higher temperatures have necessitated lighter oils of greater stability and better temperature/viscosity characteristics. A demand for improved low-temperature fluidity has stimulated solvent dewaxing processes. Of these the benzol/ketone process represents two-thirds of the world total capacity. Wax removal on this method is substantially complete, and an oil with a cloud-point almost as low as the pour-point is produced. The propane process combines dewaxing and removal of high-viscosity resins to yield a lighter and more stable oil. Solvent-extraction processes have made possible the production of premium-grade oils from mixed-base and naphthenic crudes, as well as from paraffinic crudes. Of the five leading processes, furfural, Duo-Sol, phenol, SO_2-benzol and chlorex, furfural is the most popular, probably owing to the normal extraction temperatures, 150–250° F., used. A feature of all the solvent methods is the application of instrument control, which makes for uniformity of production and more economic operation. High vacuum distillation is also used for the removal of resins and asphalt—with some oils it is more economical than solvent extraction.

In the decolorization of motor oils increased use of activated earth and bauxite has contributed to a fall in the consumption of fuller's earth. The accomplishment of decolorization in combination with distillation, with consequent saving of heat, is claimed. The demand for extreme-pressure lubricants has resulted in the production of oils containing sulphur, chlorine, and other active agents. Improvement in diesel-engine lubricants is evidenced by a steady increase of diesel-engine installations. Laboratory development of solvent extraction and molecular distillation has contributed to a better knowledge of the chemical composition of lubricating oil.

The catalytic effect of metals on the deterioration of oils has been closely studied and effective inhibitors have been produced. Other dopes have proved effective in depressing pour-point, preventing varnish formation and bearing corrosion, increasing oiliness, and raising viscosity index. R. J. E.

1381.* Lubricating Oils for Automobile and Tractor Engines. P. A. Khokhryakov. *Neft. Khoz.*, June 1939, **20** (6), 37–39.—Properties of engine oils at present produced in the U.S.S.R. by sulphuric acid treatment are considerably below those required. Production of high-grade engine oils depends on output of selective-solvent-treated oils and development of a suitable method of lowering their pour point. These engine oils should agree with S.A.E. specifications, especially regarding viscosity.

Methods of reducing pour points of sulphuric acid-treated oils should be developed at an early date so as to ensure the supply for the winter season 1939–1940. L. R.

1382.* Oxidation Tests with Roumanian Turbine Lubricating Oil. C. Candea and C. Manughevici. *Petrol. Z.*, 1939, **35** (33), 611–614.—It is possible to show by means of a laboratory test that different dopes reduce the tendency of the oil to combine with oxygen. The following materials were added as dopes: thymol, anthrazene, naphthalene, toluidine, and *para*-methyl- *para*-diamido-diphenylmethane. The ageing of turbine oil in operation being due mainly to oxidation, the authors consider it advisable to use such chemicals as stabilizers. E. W. S.

1383.* Melting Point of Solid Greases. D. S. Velekovskii, I. P. Lukashevich, and F. L. Borshchevskaya. *Refiner*, 1939, **18** (8), 312.—Structural changes brought about by details of production have a pronounced effect on the Ubbelohde melting point, but have no effect on the performance of the greases at high temperatures. Sodium base greases are heterogeneous systems, the thermal behaviour of which is greatly affected by details of production. In calcium base greases the effect of the structural peculiarities is balanced by the water present. There is no simple relation between the structure of a grease and its stability toward thermal action. The melting point is determined, other factors remaining constant, by the content of soap, rather than by the viscosity of the mineral oil used. The resins exert a stabilizing and peptizing effect. A rise in the valence of the soap base lowers the dropping temperature, the duration of melting, and the thermal stability of the grease. Increasing saturation of the hydrolysed oil or fat raises the thermal stability, the dropping temperature, and the duration of melting. G. R. N.

1384.* "Seizure Delay" Method for Determining Seizure Protection of E.P. Lubricants. H. Blok. *J. Soc. aut. Engrs*, 1939, **44**, 193–200.—Considerations of the influence of temperature on the testing and performance of so-called E.P. lubricants have so far been neglected according to this author. It is considered that in operation a "temperature flash" is superimposed on the average "bulk" temperature of gears. This "temperature flash" may last for only 0·0001 sec. and is thought to be the governing criterion for the failure of the lubricant. "Bulk temperature" should be controlled when testing such "extreme-temperature-pressure" lubricants; the failure of conventional testing methods is attributed to lack of this control. Testing technique consists in determining "seizure delay" using the familiar "Four Ball Top." This is measured by the load to cause seizure 2·5 sec. after starting the test. After seizure, equilibrium is again reached under high loads, but under still higher loads welding may occur. The amount of wear is a measure of the intensity of seizure. One peculiar phenomenon was observed in this, as in the S.A.E. machine—namely, that "incipient seizure" can occur with some E.P. lubricants at loads not much higher than those which cause failure with straight mineral oils. This is considered to be due to the fact that the temperature rise under such conditions is not sufficient to render the additive agent active. No correlation was found between results on the S.A.E. and Timken machines operated conventionally and on the "Four Ball Top" operated by the "seizure-delay" method. This is considered to be due to the uncontrolled variable of bulk temperature in conventional methods of test. Better correlation was obtained when the S.A.E. machine was operated by the seizure-delay method. Reasonably good correlation was established between results by the "Four Ball Top" using the seizure-delay method, and the lowest load at seizure in a four-square set-up of Chevrolet hypoid rear axles operated at a speed equivalent to 40 m.p.h. on the road. The temperature of the oil in the rear axle was controlled to 95–100° C. It is claimed that with the "Four Ball Top," even "strong"-type hypoid lubricants can be evaluated. The appendix to the paper is devoted to theoretical considerations. Protection against seizure is shown to be dependent on temperature at seizure and friction before seizure. The reason for taking 2·5 sec. as the time in the seizure-delay method is that this time is too short for bulk temperature to differ appreciably from ambient temperature, and the difference can therefore be ignored, and only temperature flash be considered. Practically this temperature flash can be measured by making the balls of dissimilar metals. J. L. T.

1385.* Symposium on Varnish in Engines. F. F. Kishline. *J. Soc. aut. Engrs*, 1939, **45** (2), 321–324.—Incipient varnish causes partial or intermittent sticking of valves and piston rings; in acute form varnish has been known to stick engines so that they could not be turned over with the starter. The replies of many S.A.E. members to a questionnaire on this subject reveal a wide divergence of views. Sticking-up of the engine is described as occurring when the engine is permitted to idle after normal driving, and usually happens in relatively new engines; in at least some such cases the engines were not operated under any abnormal conditions.

Several contributors were of the opinion that the varnish problem had come from a change in the character of oils. In four replies it was stated that varnish could be

rapidly produced at sump temperatures above 280° F., whilst two others were equally emphatic that high temperatures were not the primary cause. One attributed the trouble to reduced clearances in 1939 engines, whilst two others ruled out small clearances as a likely cause. One reply suggested that infrequent oil changing might be a contributory factor.

Summarizing, the author concludes that varnish is not partial to any particular engine design; it would appear that time and temperature are principal items which govern the condition, and the temperature may or may not be the sump temperature. Possibly the rate of oil circulation over hot surfaces is a factor. Closer co-ordination between automobiles and lubricants is advocated. K. T. A.

Asphalt and Bitumen.

1386. Type of Aggregate Gradation for most Suitable Asphaltic Mixtures. R. Vokac. *Assoc. Asph. Paving Techn. Proc.*, 1939, 86–123.—In a previous paper the authors described a method of selecting mixture composition by means of an isometric design chart, in which certain characteristics, such as compression strength and voids, may be determined for any mixture composition within the normal range. An investigation of the correlation of tests with service behaviour indicated that mixtures having compressive strengths of 575–1100 lb./sq. in. and voids of 2–6% were usually satisfactory, mixtures of lower strength were soft and tended to displace under traffic, whilst mixtures of higher strength were liable to crack owing to excessive hardness. It was also observed that the design charts could be separated into three main types, of which (1) represented mixtures in which smaller amounts of bitumen than usual were required and bitumen and filler contents varied widely with little effect on physical characteristics; (2) materials which gave satisfactory mixtures with a restricted range of bitumen and filler contents, and (3) materials which do not give satisfactory mixtures within the usual range. The design-chart type was found to be dependent on the aggregate gradation, and examination of a large number of curves indicated that type (1) aggregates show a wide range of particle sizes evenly distributed and a larger percentage of coarse aggregate than the other types, whilst type (2) is intermediate. It is shown that the type can be identified by the middle 50% of the gradation curve and, when a series of sieves is selected in which the mesh opening of one sieve is twice that of the next smaller sieve, if the percentage passing the various sieves is plotted against the log of the opening the portions of the curve corresponding to the middle 50% approximates to a straight line. The average percentage passing between two adjacent sieves in the middle 50% may therefore be determined from the slope of the curve. The gradation type can be decided as follows. If no single fraction contains more than 23% of aggregate and any two adjacent fractions not more than 46%, the aggregate is type 1; if any single fraction contains more than 23% and any two adjacent fractions contain 60–75%, the aggregate is type 2; if any single fraction contains 48% or more of the aggregate and/or if any two adjacent fractions contain more than 80%, the aggregate is type 3. A. O.

1387. New Vibrating Machine for Determining Compactibility of Aggregates. J. T. Pauls and J. F. Goode. *Assoc. Asph. Paving Techn. Proc.*, 1939, 124–145.—The paper describes an apparatus for determining the maximum attainable density of aggregates. This consists briefly of a vibrating table on which is mounted a cylinder having one plunger fitting into the bottom and another fitting into the top, the aggregate being contained between the two plungers. The cylinder is vibrated for 20 min. and the initial and final heights are measured by means of a micrometer dial gauge. When testing aggregates having less than 35% passing a No. 10 sieve, 50–70 ml. of kerosine are added to 750 gm. of aggregate to prevent segregation; aggregates with more than 35% but less than 50% should be tested with and without kerosine, and the highest value reported; aggregates with more than 50% should be tested dry. Tests made on various types of aggregate showed that densities obtained in circular track sections constructed with low-cost materials agreed closely with those obtained by the vibrating test; other methods of compaction generally gave lower densities. Hot plant-mix materials cut from road surfaces had lower densities than those obtained by vibrating aggregates without binder. Results are given for various types of aggregates. A. O.

1388. Comparison of Methods of Specifying Aggregate Gradations. S. Walker. *Assoc. Asph. Paving Techn. Proc.*, 1939, 146–159.—The author considers the relative merits of the method of specifying aggregate gradation in terms of cumulative percentages as opposed to separated percentages. It is thought that the methods are widely different in significance and are not readily comparable. The cumulative method is preferred, since the specification can be expressed in graphical form and tolerances are more easily decided. A. O.

1389. Composition and Testing of Asphalts of the Slow Curing Type. J. Zapata. *Assoc. Asph. Paving Techn. Proc.*, 1939, 160–194.—The paper deals with an investigation of the significance of tests applied to slow-curing liquid asphalts. Five asphalts were separated by precipitation with propane and hexane into asphaltenes, resins, and oily constituents from which a series of 131 asphalts of known composition was prepared. These asphalts were then tested according to the methods of the A.S.T.M. and the American Association of State Highway Officials, stripping and laboratory weathering tests also being made. Results obtained indicated that a definite relationship exists between composition and specific gravity, asphaltenes having a greater effect on specific gravity than resins. Resistance to stripping was found to improve with increase in specific gravity, and samples not containing asphaltenes exhibited low resistance to stripping. Absolute viscosity increased with increasing asphaltene or resin content, and the author is of the opinion that viscosity ranges in current use are not sufficiently high to enable high resistance to stripping to be obtained. Loss on heating increased with increase in oily constituents, and it is thought that the loss was due entirely to oily constituents. Evaporation is also believed to be the principal cause of increase in consistency in the 100 penetration residue test, and this test is believed to be of value in determining rate of change in service. In ductility tests at 4° C. unsuitable proportions of asphaltenes and resins or of resins and oily constituents resulted in low ductility. The fluidity factor appeared to differentiate between asphaltic and paraffinic types, and permitted of the identification of cracked residues. Positive results were obtained in the Oliensis spot test on all blends of cracked oils and on certain blends of non-cracked fractions; the original oils from which the latter were prepared gave negative results. The test for insolubility in petroleum naphtha is believed to be a useful supplement to specific gravity as an indication of resistance to stripping. It was found that results obtained with 88° Beaumé naphtha were not always consistent and did not agree with the results when using hexane, the solvent normally employed by the author. In the weathering test no definite correlation was observed between rate of increase of asphaltenes and composition, and this type of test was considered unsatisfactory. In an attempt to correlate the various tests with service behaviour a road surface prepared with S.C.-7 road oil was kept under observation for 60 weeks; samples of the mixture were taken immediately after laying and every week for two months and at the end of sixty weeks. The bitumen was recovered by Abson's method and examined for asphaltene content, resins and oily constituents, and refractive index and viscosity at 140° F. The results obtained showed that the residue at the end of 60 weeks was not appreciably hardened and corresponded to 150/200 penetration; it is therefore thought that it would be many years before the penetration reaches 100. It is also considered that evaporation is the principal cause of hardening. A. O.

1390. Asphalt Paving Equipment. F. S. Gilmore. *Assoc. Asph. Paving Techn. Proc.*, 1939, 195–216.—A review is given of developments in the use of plant and equipment in the maintenance of asphalt paving. A. O.

1391. Surfacing Asphalt Pavements for High Light Visibility. C. A. B. Halvorson. *Assoc. Asph. Paving Techn. Proc.*, 1939, 217–241.—It is pointed out that under city lighting objects are seen by light reflected from their vertical surfaces, and details and colour contribute to visibility, whereas on arterial roads, owing to low illumination, objects are generally seen in outline contrasted against the brighter background. Road surfacings absorb light in varying degrees, and certain surfacings give diffuse reflection, others specular, whilst some lack uniformity of reflection over large areas necessary for proper visibility at night. Pavements and paving materials generally change in

light reflection coefficients and characteristics when wet, and brightness uniformity varies greatly with the specific intensity, direction, and angle of the applied light. The brightness appearance of some pavements is also greatly affected by differences in surface texture and finish, under the variation in quality and direction of daylight. In tests on a model road having a wet, smooth, black surface, two light-coloured objects with matte surfaces of identical reflectivity were placed on the pavement; one of these appeared black against the longitudinal image of the source of light reflected on the pavement, whereas the other appeared white, being illuminated by light directed away from the camera. The surrounding pavement appeared dark owing to the direction of light falling on the wet surface, and a dark object would be practically invisible in this area. Under the same conditions but with a dry diffusing or matte surface the objects still appear black and white, but since the pavement reflections appear as transverse areas they are clearly visible. Pavements of fine texture, irrespective of their dry diffuse reflectance factor, when wet reflect sources of light as in the first experiment. This is due to the small particles being submerged by a film of water. Open-surfaced pavements usually conduct the water away and prevent formation of a film, and when the aggregate has reasonably high diffuse reflectance of the wet emergent surface behaves as in the second experiment. In experiments made to determine how visibility and economy are affected by difference in behaviour of two types of pavement differing widely in diffuse reflectance under artificial lighting, an open-type macadam pavement with a dark surface of low diffuse reflectance value was illuminated by shading-type luminaires 120 ft. apart, staggered and fitted with 400-watt Mazda lamps. Under this lighting the pavement appeared as small spots of brightness alternating with large areas of darkness. Four targets having surfaces painted vertically half white and half black were placed in the traffic lanes at distances of 100 and 200 ft. from observers. The white portions were easily seen in contrast with dark areas of pavement, but although the black portions were approximately the size of a human being, it was only possible to see them in two cases; these were silhouetted against the bright areas of pavement. The road was then surface dressed with $\frac{1}{4}$–$\frac{3}{4}$ in. granite chippings, producing a matte surface, and although other conditions remained as before, the pavement now appeared reasonably bright, and black portions of the targets were clearly visible. This change resulted in improvement in brightness of about threefold. Adjustments to light distribution of the luminaires gave a relative improvement in the shadow of about 4 to 1. The information obtained indicated that properly designed lighting giving uniform illumination on a matte surface from overhead would produce uniform brightness from any angle. In bright sunlight the pavement was appreciably less bright when facing the sun than the original pavement. The pavement was also uniformly bright when wet and visibility distance with automobile headlamps was increased several times. Visibility of objects was high and the pavement appeared uniformly bright under a cloudy sky.

A. O.

Special Products.

1392. Propane Precipitation of Petroleum Resins. P. T. Graff. Symposium on Plastics and Resins from Hydrocarbons. Amer. chem. Soc. Meeting, Boston. September 1939, pp. 5–14.—The residue from the distillation of crude petroleum may be separated into asphalt, resins, and lubricating-oil fractions by precipitation with liquid propane. This generally involves a two-stage process, the first stage being concerned with the separation of asphalt, whilst the second effects the separation of the resins.

These petroleum resins contain those hydrocarbons or colour bodies which are adsorbed on clay or earths in the refining of lubricating oils. They are similar to asphaltenes, except that they are not oxidized or combined with sulphur, and are thus soluble in petroleum ether.

This precipitation of resins is used commercially to reduce the duty of clays in decolorizing lubricating-oil stocks. The products obtained may vary greatly in composition, depending on the nature of the residual oil and its previous history. They may be very narrow cuts on the crude, and consist essentially of bodies with a

high C : H ratio. On the other hand, with broader cuts they may be associated with high-molecular-weight lubricating fractions.

Diagrams illustrating the effect of propane de-resining are included in this paper.

D. L. S.

1393. Production of Petroleum Resins. S. C. Fulton and A. H. Gleason. Symposium on Plastics and Resins from Hydrocarbons. Amer. chem. Soc. Meeting, Boston. September 1939, pp. 15–28.—The paper first deals with the resins which occur naturally in petroleum, and those formed during cracking processes.

Two methods are given for recovering the latter from cracking coil tar: (1) the tar is vacuum-distilled to a residue with softening point 105–115° C. This residue is extracted with a refined petroleum distillate, the solution filtered from finely divided and suspended asphaltenes, acid treated, and finally distilled to recover the resins. (2) Tar is distilled to a low-melting-point pitch, which is treated with anhydrous aluminium chloride under condensing and polymerizing conditions without dilution. Treatment with sulphuric acid and subsequent neutralization follow, after which the resins are separated by distillation under reduced pressure.

These two classes of resin are not of good quality as regards colour and melting point, and a better-quality product can be synthesized from light distillate oils by the Formolite process. The most satisfactory resins as regards colour and melting point have been prepared by refluxing a mixture of aromatic hydrocarbons, formaldehyde, and zinc chloride in glacial acetic acid. The four components of this reaction are discussed separately, and the influence of each on the final product is described.

Resins prepared from highly aromatic light petroleum distillate and formaldehyde are amber to pale yellow in colour, are very brittle, and have melting points up to 140° C. They can be used with success in paints and varnishes.

As regards heavy distillate oils, in addition to formaldehyde condensations, two other methods of resinification have been satisfactorily employed. These involve chlorination and either thermal dechlorination or condensation with metallic halides.

(*a*) *Resins Produced by Chlorination and Dechlorination.*—Cracked petroleum tar is distilled under vacuum conditions and the distillate chlorinated slowly at room temperature until 10–15% of Cl_2 has been absorbed. The chlorinated distillate is then heated and distilled, and the bottoms, after some cooling, are agitated with a selective solvent. This is then distilled off to recover the resin.

(*b*) *Chlorination and Condensation with Metallic Halides.*—As in (*a*), the distillate is chlorinated. It is then treated with 2–10% of a metallic halide such as aluminium, ferric, or zinc chlorides at 75–100° C. for about 10 hr. After decomposition of the catalyst, unreacted material is removed by distillation to 320° C. at 1 mm. pressure. The residue is selectively extracted to recover the resins.

From all these processes resins can be obtained with physical and chemical properties such as to make them appear interesting for a variety of purposes. D. L. S.

1394. The Properties of the Polybutenes and their Uses in Petroleum Products. R. M. Thomas, J. C. Zimmer, L. B. Turner, R. Rosen, and P. K. Frolich. Symposium on Plastics and Resins from Hydrocarbons. Amer. chem. Soc. Meeting, Boston. September 1939, pp. 29–51.—The production of polybutenes of molecular weights ranging from 25,000 to 400,000 and higher from *iso*butene is now an established process. These polymers may be classified according to their molecular weights as determined by the Staudinger method, which depends on the increase in viscosity of a solvent due to the solution of the polymer.

The polybutenes vary from liquids to white, tough, elastic solids having a H : C ratio 2·0. They are odourless and tasteless when pure, and have a specific gravity of approximately 0·9, which varies slightly with the molecular weight. They are more resistant to heat, ultra-violet light, and mechanical working than rubber. They are soluble in liquid aliphatic hydrocarbons, and except for the high-molecular-weight members, in aromatics as well, and have the property of increasing the viscosity index of petroleum oils.

They are used in motor oils for improving the viscosity index, and because of their stringy properties are of great value in greases and special lubricants. A method of measuring the stringiness of blends is described. In asphalts these polymers tend to

raise the softening points and increase the penetration, whilst improving the ageing properties of these products. Paraffin wax is also improved in some directions by admixture with polybutenes. Thus the low-temperature flexibility of wax can be considerably modified by this means and the adhesion of waxed surfaces rendered more satisfactory.

Amongst other uses may be included their utilization in (*a*) motor fuels, (*b*) shock-absorbing liquids, (*c*) cosmetics and medicinal preparations, and (*d*) compositions for impregnating leather. D. L. S.

1395.* Comparative Data on the Characteristics of Activated Lampblack from Methane "Carbomet No. 3." G. Vulpescu, *Monit. Pétrole roum.*, 1939, **40**, 1009–1012.—"Carbomet No. 3," a product of the Société Nationale de Gaz Méthane, is an activated carbon black the physico-chemical characteristics of which show it to be as good as the best-known American grades, tests of which are given in comparison with Carbomet No. 3. An account of the methods of testing is given in this paper. They include: (1) the heat of wetting by benzene which is a function of particle size, (2) adsorptive capacity, (3) maximum adsorption. Adsorptive capacity is measured best with diphenylguanidine (D.P.G.), which has a straight-line adsorption isotherm. The sample is treated with 0·01*N* solution D.P.G., shaken, and then centrifuged; after titration of excess D.P.G. with 0·01*N* hydrochloric acid the index of adsorption is calculated. Maximum adsorption is measured by passing air saturated with an organic solvent such as carbon tetrachloride through the carbon black until the latter ceases to gain in weight. R. D. S.

Detonation and Engines.

1396.* Prospects for Use of "Safety Fuels" in Spark-Ignition Aircraft Engines. F. C. Mock. *J. Soc. aut. Engrs*, 1939, **45**, 291–294.—Recent developments in fuel-refining processes have revived general interest in the subject of safety fuels, and this article summarizes the probable programme necessary before such fuels can be employed successfully in everyday service operations. As such fuels so far seem inherently to have a lower calorific value than gasoline, they start off with a handicap of from 3 to 7% in fuel consumption as compared with gasoline, and any successful development must achieve as complete combustion of both air and fuel charge in the cylinder and as accurate metering of the fuel/air ratio as are now obtained with the newer carburettor systems.

The author confines his analysis of the problem to the use of fuel injection, as with this system the two outstanding difficulties encountered—viz., obtaining adequate heat for fuel vaporization and subtracting heat from the hottest parts of the combustion chamber—are brought into mutual solution. Injection equipment at present available should be satisfactory, but to co-ordinate pump delivery with air throttling it is necessary that a scale should be provided indicating the fuel charge delivered at each position of the pump control. Satisfactory operation cannot be obtained in any present engine without changes to affect turbulence and temperature distribution. Single-cylinder engine tests should be made at all loads and speeds encountered in service, and special attention should be given to cool engine operation. Tests on a radial air-cooled engine and a Prestone cooled single-cylinder engine injecting into the cylinders and using fuel of 87 octane number have shown satisfactory results, and in the case of the latter engine it was found necessary to raise the piston crown temperature to form a "hot spot," as the combustion chamber walls ran below the boiling point of the fuel. Suggestions are made with regard to the starting problem with safety fuels, and in connection with the installation of the injection equipment. In the author's opinion the completion of the work necessary for a complete solution of the problem must be undertaken by the engine manufacturers, and would require at least 2½ years. C. H. S.

1397.* Trend in Poppet Valves. A. T. Colwell. *J. Soc. aut. Engrs*, 1939, **45**, 295–304.—Although during the past year no entirely new development has been forthcoming,

many improvements upon existing performance have been achieved. These improvements have been the outcome of studies connected with grain flow, structure, forging temperature, coolants, and interior construction. In addition, 300 analyses of valve steels were examined and intensive work on twenty steels showed four of definite merit. The results of investigations dealing with sodium cooling and head designs by means of glass valves are illustrated and discussed, and chemical and physical analyses of four outstanding valve steels are given, the steels concerned being Silcrome No. 1; Silcrome XB; Silcrome X10; and Silcrome XCR. The author also discusses rotating valves, valve guides, valve-seat inserts, "superfinish," and various surface treatment processes. C. H. S.

1398.* Aviation Fuels and Engines. F. R. Banks. *J. Soc. aut. Engrs*, 1939, **45**, 389–406.—The first part of this paper reviews the present position regarding aviation fuel in Great Britain, and particulars of the leading British engines are given, together with their performance on the fuels used. It is claimed that British engines can take greater advantage of the temperature-sensitive fuels, such as gasoline/benzol and gasoline/benzol/alcohol blends, than some of the typical American engines, instances being quoted where the latter engines with hemispherical two-valve heads gave trouble with overheating on such fuels, whereas a well-known British air-cooled engine with four valves per head gave no trouble. A theory is put forward to account for the differences experienced in this respect. It is believed that the greater rotational swirl given to the fuel/air charge in the two-valve head renders this type of engine more sensitive to spark-plug position, spark timing, and the fuel used than is the case with the four-valve head, in which this rotational swirl does not occur. Comparisons between temperature conditions; m.e.p.'s, and speeds of typical American and British engines are given which indicate that temperatures alone cannot account for the differences noted in respect to behaviour on these so-called temperature-sensitive fuels.

Considerable data are given on special fuels for racing purposes with which the author has had a wide experience; and particulars are given of their performance in engines used for record-breaking purposes.

Differences in British and American valve technique are dealt with, and some account is given of the new development in exhaust-valve manufacture which employs "Brightray" (an 80/20% nickel chromium alloy) for valve faces and complete valve forgings.

The advantages claimed for the single-sleeve valve by its protagonists are discussed individually, and whilst the author admits that the Bristol Co. has done an excellent job in bringing the sleeve valve to its present state of development, he nevertheless contends that this type of engine has not shown itself to be a development which demands immediate adoption regardless of all other considerations.

An important development in England in the last year or two has been concerned with the use of sintered aluminium-oxide spark-plug insulators, which were first produced by Siemens in Germany. The use of this material with fine earth wires has proved extremely satisfactory, and very long life is now being obtained with these plugs. This subject is discussed at length, and many illustrations of this type of plug and the latest type of shielded cable elbow employing bakelite insulation and 1000 ohm resistor between cable and plug are given.

The use of fuel injection is discussed, and the author thinks that this method which is now largely used in Germany should be seriously tried out, particularly in the case of large multi-cylinder supercharged engines, in which distribution difficulties are likely to be encountered.

The future development of engines must depend on the future requirements of aviation, and these appear likely to be governed by military needs for some time to come. The latter section of the paper deals with probable development for such purposes.

It would appear that engines of 2000 b.h.p. up to, say, 5000 b.h.p. are likely to be required in the next few years, and the author thinks that the liquid-cooled engine will probably be employed for these higher powers, as it offers more scope in dealing with the increased heat flow which will be encountered. Compactness of design and greater rigidity are also possible with this type of engine. There will probably be

three main types—viz., the "X" engine with four banks of six cylinders each; the "H" engine, arranged either vertically or on its side; and the multibank radial, with in-line cylinder arrangement. Probable general design features of such engines are discussed, especially with regard to number and optimum size of cylinders, and the main points for and against the Diesel or C.I engine are dealt with. Appendices deal with tests on 87 and 100 octane fuels in a Napier-Halford "Dagger" twin-cylinder test unit, and a report by the Chemical Standardization Committee of the Institute of Petroleum on Secondary Reference Fuels. C. H. S.

1399.* Precision of Knock Rating, 1936–1938. D. B. Brooks and Robetta B. Cleaton. *J. Soc. aut. Engrs*, 1939, **45**, 449–456.—The first analysis of detonation rating data on Co-operative Exchange Samples was completed by the U.S. Bureau of Standards in the report presented to the C.F.R. Detonation Subcommittee on 4th May, 1936. The Bureau was later requested to make a second analysis of the Co-operative Exchange fuels since June 1936, and the present report analyses the results obtained in 6386 tests on 136 fuels, the tests being made by over 100 laboratories.

This report shows that the accuracy of knock-rating tests when corrected to 70 octane number, and expressed as standard deviation, has improved from 0·63 octane unit in the previous analysis to 0·52 octane unit in the present analysis.

The general improvement in precision averaged over 20% on all types of fuels, but although the improvement has been large for fuels of 70 octane number, it has been nil for those over 80-octane number. Results on cracked fuels of 70 octane number showed less precision than those on straight-run fuels of the same octane number. The 1939 Research Method was definitely more precise than the older Research Method.

The effects of atmospheric and engine variables reported in 1936 are substantiated in general, and it is concluded that more attention should be given to the correction of compression ratio for barometric pressure. It also appears that better results would be obtained if not more than 100 hr. were allowed to elapse between overhauls of rating cracked fuels. Humidity control is also recommended. C. H. S.

1400.* Automobile Cooling and its Associated Problems. C. S. Steadman. *J. Instn aut. Engrs*, 1939, VII (10), 27–53.—This paper is intended to be a general survey of automobile cooling-system practice, together with associated problems. The performance of a cooling system can be conveniently expressed by the "Critical Air Temperature"; this is the maximum atmospheric temperature at which the car can be operated continuously under specified load conditions without boiling. Heat dissipation from the radiator is proportional to the difference between mean air and water temperatures across the radiator system; hence the critical air temperature (C.A.T.) can be estimated from track or chassis dynamometer tests at any convenient lower temperature. The C.A.T. of the typical large American car is 45–47° C. under full throttle conditions and approximately 20° C. under idling conditions. The latter figure proves to be fairly adequate for practical traffic conditions. For the British market a full-load C.A.T. of 35° C. is considered satisfactory.

Methods of radiator construction are reviewed, and data given regarding heat dissipation from different matrices. For maximum economic cooling effectiveness the water-pump output should ensure a temperature drop across the radiator at maximum speed full throttle of 6–8° C. This means a flow of 25–30 gal. per min. for a 30-h.p. car. The fan for a car of this size may absorb 8–10 h.p.

For optimum operating conditions the coolant temperature should be kept in the neighbourhood of 80° C. This temperature should be reached with a minimum delay after starting from cold. Various methods of thermostatic control are discussed, and it is concluded that requirements are best met by a thermostatic valve in the top water-pipe with a large by-pass to the water pump inlet. The thermostat is arranged to start cutting off the by-pass as the main valve begins to open; when the latter is fully open the by-pass is entirely closed. Under-bonnet temperatures are much lower with water-circulation control than when radiator shutters are used.

With high-powered engines an oil cooler is often necessary. Cooling of the oil may be effected by air, as with the main water system, or by means of a honeycomb matrix through which the main cooling water passes. The latter method also helps to warm

up the oil when starting from cold. Oil coolers should be capable of withstanding an internal test pressure of 200 lb. per sq. in.

The author points out that the causes of overheating troubles often lie in the engine itself, such as stagnant water pockets which result in steam formation. Pressure cooling is considered to have distinct possibilities; the system is sealed by a blow-off valve and is designed to operate above atmospheric pressure at full capacity. The boiling point is thus raised, and a smaller radiator can be used. In one such system the pressure was 12 lb. per sq. in., the boiling point 117·5° C., and the radiator weight was reduced by 35%. K. T. A.

1401. The Work of the D.V.L. F. Seewald. *J. R. aero Soc.*, 1939, **43** (343), 508–545.—The D.V.L. is the central scientific aeronautical research institute in Germany. An outline is given of its constitution and its recent activities under three headings: (1) the aeroplane, (2) the engine, and (3) equipment. In regard to engine development the requirements being studied are increase in cruising altitude, performance, and range.

Since 1936 many tests have been made in the altitude chamber on liquid- and air-cooled engines, with particular reference to supercharging. It is now possible to maintain constant pressure up to 10 km. with a single stage, and without cooling of the compressed air before admission to the motor. An outline is given of the progress in development of exhaust-driven turbines with air-cooled rotors. The possibilities of sleeve-valve motors have been studied, with promising results. Investigation of long-range power units has indicated that the possibilities of the two-stroke diesel motor appear to be favourable for flight at medium altitudes; for high altitudes the ignition motor developed to give economical operation, as well as the four-stroke diesel motor, both with exhaust gas turbo superchargers, promise successful application.

Experiments on the atomization of fuel jets are illustrated by spark-discharge photographs. The velocity of the fuel drops in the centre of the jet is greater than that at the edges. It can be shown that self-ignition of the fuel takes place at the edge of the stream. K. T. A.

Economics and Statistics.

1402.* 1938 Drilling Results of Azneftedobycha and 1939 Perspectives. M. S. Shishkanov and N. Ya. Udyanski. *Azerb. neft. Khoz.*, January 1939, **19** (1), 12–15.—During eleven months of 1938 only 75% of the plan in terms of depth drilled have been fulfilled, and in place of 913 wells planned only 611 (67%) have been sunk. The number of survey wells drilled has been 55% of that planned. Percentages of plan fulfilment are given for individual trusts belonging to Azneftedobycha. Reasons for failing to reach plan figures are analyzed, the main cause being the great number of breakdowns. During the eleven months a total of 1399 breakdowns have been reported, taking 9·4% of working time.

Organization of drilling is examined in detail, and found unsatisfactory. 6·1% of total working time were lost through unexpected troubles during drilling, whilst time loss due to bad organization amounted to 13·5%. In total, 31·8% of the working time was lost. Unsatisfactory results are traced to incorrect drilling practice, resulting in a great number of crooked holes. Drilling equipment is often not appropriate—for example, bits not suited to soil hardness. Drilling mud is carelessly prepared and insufficiently screened. Modern methods, although approved, find slow introduction.

Measures for avoiding past mistakes in 1939 are indicated, including, (*a*) improved organization, (*b*) preparation of standard plans for erecting derricks, (*c*) necessity of dragging derricks wherever possible, (*d*) selection of right type of pipes, (*e*) use of three-cutting-edge bits where possible, (*f*) use of coarser-grain material for cementation, etc. L. R.

1403.* World Legislation Affecting Petroleum. Anon. *Bol. Inform. Petroleras*, June 1939, XVI (178), 60–70.—This is a continuation of a reference index to various laws affecting the petroleum industry, contained in No. 174 and subsequent numbers. H. I. L.

1404.* Project for Increasing the Customs Duties on Refined Combustible Liquids in Uruguay. C. R. V. Garzon. *Bol. Inform. Petroleras*, June 1939, XVI (178), 71–76.—Full particulars are given of the increases which have been sanctioned with a view to protecting the home refining industry. Advice is given of a contract made with the Associated Ethyl Co., Ltd., London for the supply of Ethyl Petrol of seventy-four octanes. H. I. L.

1405.* New Laws Decreed Affecting the Import, Export, Transport, Distribution and Refining of Petroleum and its Derivatives in Brazil. Anon. *Bol. Inform. Petroleras*, June 1939, XVI (178), 77–83.—This is a verbatim copy of the decree. H. I. L.

1406.* Production in the Argentine for the first six months, 1939. Anon. *Bol. Inform. Petroleras*, June 1939, XVI (178), 1–2.—The figures show a net increase over the corresponding period in 1938, of 82·15% for the Y.P.F. and of 17·85% for private companies. An interesting graph is included, showing the prices of petrol from the year 1920 ($0·35) up to the present time ($0·18). H. I. L.

BOOK REVIEWS.

Oil-Field Exploitation. By Lester Charles Uren (Professor of Petroleum Engineering, University of California). Pp. 756. 9 × 6, 386 illustrations. McGraw Hill Publishing Co., Ltd., Aldwych House, London, W.C.2. Price 36*s*. net.

The publication of this volume completes the revision and rewriting of the author's original work on Petroleum Production Engineering, published in 1925.

The important advance made in oil-field technology, thereby placing it on a much higher technical plane, has necessitated the rewriting of a large part of the original work, and it has been found necessary to divide it into two volumes, which the author (the well-known professor of Petroleum Engineering at the University of California), has subtitled as follows: (1) Oil-field Development, (2) Oil-field Exploitation. The former was published in 1935, and covers the period from the securing of the land for development purposes, up to the completion of the wells in preparedness for production. The latter volume, published this summer, covers the period up to the time the oil is ready for delivery to the market.

The author has used as his background the lectures given by him to senior petroleum engineering students, on which he has enlarged, and has drawn on his vast knowledge and experience and from the published literature on petroleum technology in the technical press, the journals of various learned societies, and from publications of the U.S. Bureau of Mines.

The industry, therefore, is furnished with a work which combines the very latest thought and practice, and which provides it with a proper perspective, together with a knowledge of its terminology, equipment, and methods.

Each volume comprises twelve chapters, is profusely illustrated, and is complete in itself.

In the present volume the author deals, at the outset, with the various principles appertaining to oil drainage, and analyses reservoir conditions and factors affecting the removal of oil from same, the discussion of the retentive forces restricting petroleum drainage, capillarity, adhesion, and flow friction, and characteristics of oil and gas wells. The following five chapters deal entirely with the recovery of oil and the various methods employed and the equipment in use. In proper sequence the ages of a well are dealt with, from the flowing period, and the control of flowing wells, and the various pressure-recording devices required.

As the latent energy within the oil deposits is gradually expended, secondary methods of recovery are called for, and, in the chapter termed by the author "Pneumatic Pumping of Oil Wells," various forms of gas lift, multi-stage gas lifting, intermittent flow devices, displacement pumping, and plunger lift are discussed and described, together with the surface equipment utilized.

Some 135 pages are allocated to the various mechanical devices for lifting oil from wells, following decline of natural and induced methods of oil production. The fullest description is given of the types of equipment employed both in the wells and on the surface.

Discussion is next made of the methods employed on the field for improvement of recovery, efficiency, and reduction of production costs. The author emphasizes the importance of sand control in well operations and describes the various types of screens used in finishing the wells, which are also illustrated. Gravel packing or screening on the outside of the oil string, removal of inorganic precipitates from the well, which tend to prevent access of the oil, and flooding of the oil sands with oil from inside the tubing via the screen perforations, are surveyed. The author, by means of a diagram, emphasizes the advantage to be gained by completing wells with as large a diameter as possible, to ensure an increased influence over a larger drainage area, to allow of wider spacing of wells and consequent lower development

and producing costs. This leads him to an explanation of the use of explosives for the purpose of increasing drainage area around a well, and also the treatment by acid (hydrochloric) to increase production from wells producing from limestone reservoir rocks and prevention of corrosion of casing by use of an inhibitor.

Having explained the most efficient methods of well operation and control, by use of latent energy within the oil deposits, also the various artificial methods for prolonging the flow life of wells, the author proceeds to the study of "Secondary Methods of Oil Recovery," in which are included the application of vacuum to wells, gas injection, water flooding processes, and, finally, various types of mining for oil for further recovery. A cross-section of the mine at Pechelbron is included, and an explanation of the later method employed at the mine, both for better recovery and greater protection.

The concluding chapters, under a heading "Preliminary Refining of Petroleum," deal with the treatment of oil on the field prior to despatch. This includes separation of gas from the crude, water dehydration methods, and breaking up of emulsion, so that when the oil is finally despatched it is as free from impurities as possible.

There is an excellent chapter covering the gathering of oil on the surface and local storage requirements, gauging, sampling, testing of oil and gas, followed by another chapter on bulk storage, transport by way of oil and gas lines with suitable tables for flow, resistance to flow, etc., also transport by road, rail, and water. In the final chapters the author deals with auxiliary plant, such as workshops, etc., and various departments and their personnel, and concludes with a detailed account of office methods and records as customarily applied to the industry.

The book is neatly bound and printed on good paper. Sufficient tables and diagrams with formulæ are provided to expedite the sundry arguments requiring elucidation.

Each chapter opens with a reasoned preface of the subjects embodied and, for those readers requiring still further information regarding any special subject in which they may be more particularly interested, a selective bibliography has been included at the end of each chapter.

The author has made this highly technical subject interesting reading, and the complete work forms a standard reference for all engaged in the industry.

This is a masterly treatise and no one is better fitted or more qualified than the author to undertake so gigantic a task.

R. J. WARD.

IIme Congrès Mondial du Pétrole; Comptes Rendus. Published at 85, Boulevard Montparnasse, Paris, 6e. 11″ × 8½″. 5 volumes:

Vol. I. Geology, Geophysics, Drilling; 1021 pp.; 36*s.*; $9.00.
Vol. II. Physics, Chemistry, Refining; 1230 pp.; 60*s.*; $15.00.
Vol. III. Materials and Construction; Utilization; 902 pp.; 44*s.*; $11.00.
Vol. IV. Economics and Statistics; 805 pp. 28*s.*; $7.00.
Vol. V. General Information; 94 pp. 8*s.*; $2.00.

Prices given are for copies bound in cloth. Vols. I–V when purchased together are £7 9*s.*; $37.00. Postage and packing charges outside France: 10 per cent. extra on the above prices.

Publication of the *Proceedings* of the Second World Petroleum Congress, organized by the Association Française des Techniciens du Pétrole and held in Paris in June 1937, was completed early in 1939. There are five volumes. The contents of these volumes are approximately indicated by their titles given above. This list of titles does not do justice, however, to the remarkable range of subjects covered in each volume—a range far wider than was attempted at the First World Petroleum Congress of 1933. Altogether, there are 426 Papers, which, together with reporters' summaries, discussions, speeches at the plenary sessions, etc., make a total of over 4000 pages. It is a testimony to the vigour of the petroleum industry that the scientific studies should mainly relate to the three years intervening between the First and Second Congresses; and to the catholicity of outlook of the French Organizing Committee that nothing pertaining to petroleum was considered alien from the interests of the

Congress, whether legal, fiscal, archæological, statistical, educational or purely scientific in character.

Volume I comprises two parts. Approximately one-third of the book consists of general reports on petroleum developments in various countries between 1933 and 1936. The remaining two-thirds consists of Papers on geology, geophysics, drilling and exploitation respectively. The general reports were an innovation. Mainly historical in character, they form a valuable source of reference to the countries concerned. The geological Papers are for the most part regional studies. Geophysics is represented by twenty-three Papers notable for examples of specific surveys. Drilling is mainly concerned with rotary developments and nine Papers on drilling muds. The section on exploitation, *i.e.* production engineering, is somewhat disappointing. There are many aspects of reservoir dynamics not represented.

Volume II, the largest of the five volumes, contains Papers coming within the broad categories of " Physics, Chemistry and Refining " of petroleum products, although it is not always clear why some Papers (on lubricants in particular) were allocated to Volume II and others to Volume III (Section " Utilization "). The influence of chemical trends between 1933 and 1936 is clearly indicated by the sectional arrangement adopted—de-waxing, solvent refining, hydrogenation, utilization of petroleum gases, oxidation of lubricating oils. Additional sections deal with analytical methods and viscosity.

The first part of Volume III, " Materials and Construction," constitutes a grouping of Papers that is unique, in that it brings together the chemical engineer, the electrical engineer and the metallurgist to the study of problems encountered in refinery construction. The principal topics discussed are corrosion, high-pressure plant, evaporation losses and electrical equipment for refineries. " Utilization " in the second part of Volume III is mainly concerned with fuels and lubricants for internal-combustion engines.

Volume IV and the section which it represents, " Economics and Statistics," was admittedly an experiment—and a remarkably interesting and successful experiment it has proved to be. The title of the volume is somewhat of an omnibus character, because this volume treats of a wide diversity of subjects. There is, for example, a 150-page dictionary of petroleum terms in French, English, and German (in English alphabetical order). The preparation of this dictionary represents many months of compilation and checking by those responsible. There is a section on the archæology of petroleum; a section on legal enactments controlling exploitation in various countries; various Papers on standardization of methods of testing and nomenclature; and a short section on education.

The final volume of the *Proceedings* contains reports of speeches at various functions, the lecture by Prof. Henri Weiss, delivered before M. Albert Lebrun, President of the French Republic, and a list of the personnel of the different national committees, delegates, and members attending the Congress. A number of pencil sketches, reproduced from *La Revue Petrolifère*, add to the interest of this volume.

Three official languages were adopted—French, English, and German. It would probably be a fair approximation to say that 80 per cent. of the text is in French, 10 per cent. in English and 10 per cent. in German. Abstracts of the more important technical Papers have already appeared in the *Journal* Abstracts during 1939.

The President of the First Congress, in declaring open the Second, said that Research and Fellowship were the twin motives that underlay international scientific gatherings of such a nature. The research is recorded in these *Proceedings*. In due course it becomes absorbed into the ordinary workaday technique. The fellowship remains.

S. J. Astbury.

BOOKS AND PUBLICATIONS RECEIVED.

Petroleum Facts and Figures. 6th Edition. 1939. The American Petroleum Institute, New York, pp 190. $1.00.

The sixth edition of these statistical tables relating to the American petroleum industry continues the data of previous editions down to the end of 1938. The tables are grouped under the headings of Utilization, Production, Refining, Transportation, Marketing, Prices and Taxation, and General (Employment, Accident Rates, Fire Losses, etc.). The source of the data is indicated in the case of every table. Salient features are emphasized in the titles given to the tables (*e.g.*, "One Gasoline Pump in Use for every Twenty-one Cars," "Two-thirds of Wells Drilled find Oil," "California Largest Residual Fuel Oil Producer," etc.) and by an extensive use of "pictograms." A valuable Appendix contains particulars of the organization and personnel of the American Petroleum Institute, a directory of 121 petroleum associations in U.S.A., and a useful list of A.P.I. publications.

The book is sponsored by the Department of Public Relations of the American Petroleum Institute, and the Foreword pays a tribute to Mr. Edwin W. Esmay for the work of compilation and editing.

The Machining of Copper and Its Alloys. C.D.A. Publication No. 34. Pp. 108. Issued by the Copper Development Association, Thames House, Millbank, London, S.W.1.

This publication, which discusses the machining properties of copper alloys and summarizes modern machining practice as applied to these materials, contains a few pages on cutting fluids. These include alkaline solutions, and soluble, mineral, fatty, blended and sulphurized oils.

NEW PUBLICATION.

Petroleum. Vol. I, No. 1, October 1939. Size $8\frac{1}{2} \times 5\frac{1}{2}$ in. Pp. 1–36. Published monthly by Leonard Hill, Ltd., at 17, Stratford Place, London, W.1. Annual Subscription 10*s.* post free; abroad 12*s.* 6*d.*

The first issue of this publication contains the following signed articles: "Safety a Science," by C. L. Hightower; "Petroleum Products in Industry," by S. F. Daley, and "Unit Processes in Oil Refining," by M. E. Clark. In addition, there are anonymous articles on pipe-line, underground storage, Germany's oil needs, and diesel fuel, together with editorial comments and items of topical interest. A selected list of recent patents is given.

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INSTITUTE NOTES.

DECEMBER, 1939.

FORTHCOMING MEETINGS.

Thursday, 25th January, 1940: Northern Branch; Luncheon Address by the President in Manchester. (Full details to be announced later by the Hon. Secretary of the Northern Branch.)

Friday, 26th January, 1940: at 2.40 p.m. at the Royal Society of Arts, John Street, London, W.C.2.

Presidential Address by Professor A. W. NASH, M.Sc., F.Inst.Pet.

STUDENTS' MEDAL AND PRIZE.

The Council offers annually a Medal and Prize (to the value of Five Pounds in books) for the most meritorious essay on a subject connected with petroleum technology submitted by a Student Member of the Institute.

The conditions of award for 1939–1940 are on a different basis than in previous years, in that Students must submit essays on one of the subjects in the following list:

1. Geological structures favourable to the accumulation of oil.
2. A comparison of the various geophysical methods of prospecting for oil.
3. The controlling factors of deep drilling.
4. Mud fluids for drilling purposes.
5. The principles of three-dimensional flow of fluids through porous media.
6. Special products manufactured from petroleum.
7. The sweating of paraffin-wax scales.
8. The behaviour of fuel oils in compression-ignition engines.

Entries must be received by the Secretary of the Institute not later than 1st May, 1940.

No maximum length of essay is specified, but in general essays should be from 4000 to 6000 words in length.

Entries must be typed, and one carbon copy must be furnished in addition to the original copy. The Council is prepared to assist Students who experience difficulty in getting their MSS. typed.

BURGESS PRIZE.

Entries are also invited for the Burgess Prize (of value up to Five Pounds in books) for an essay dealing with some aspect of the economics of the petroleum industry, including the transport and distribution of petroleum products.

The conditions of entry for the Burgess Prize are the same as for the Students' Medal and Prize.

The Council reserves the right to withhold the award of either of these prizes, or to award prizes of such lesser values as it may decide.

ARTHUR W. EASTLAKE,
Honorary Secretary.

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ABSTRACTS.

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Commencing with the November issue of the *Journal* (No. 193), every Abstract of which the original article is available at the Institute's office in Birmingham is indicated in the *Journal*. The original can be borrowed by members in Great Britain through the post.

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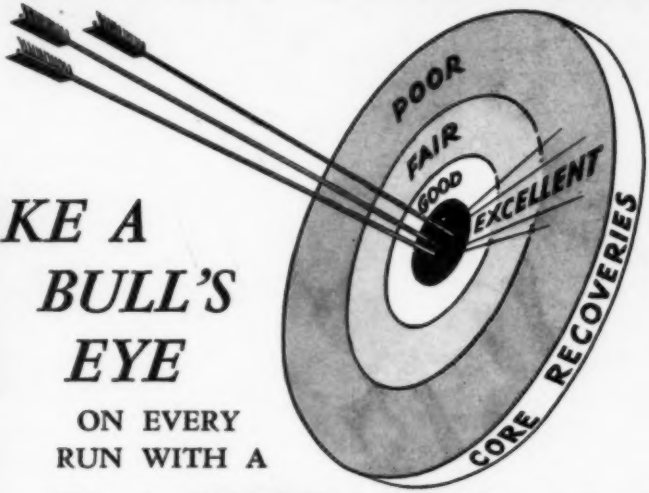

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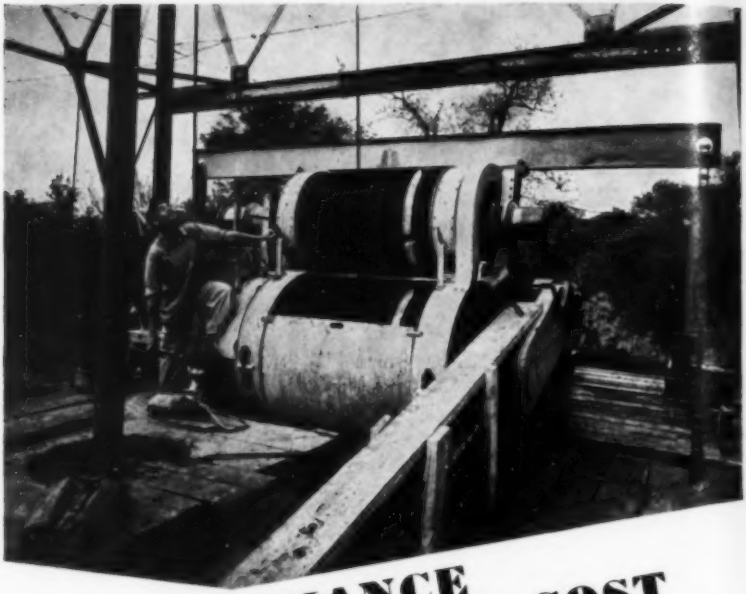

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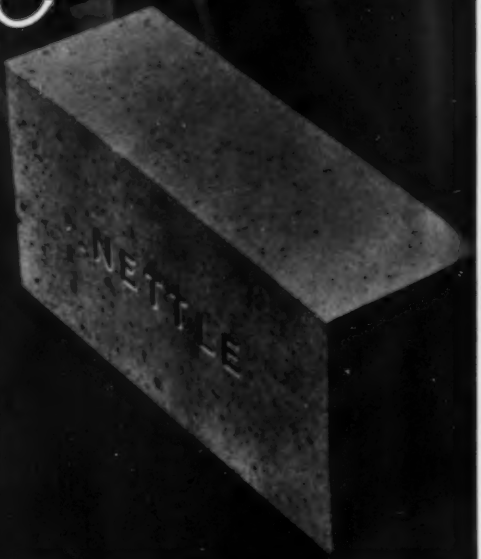

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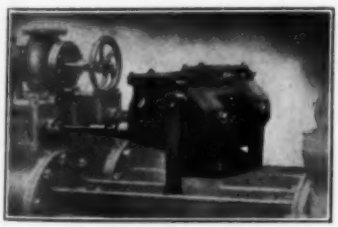

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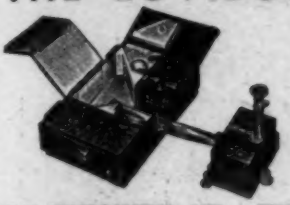

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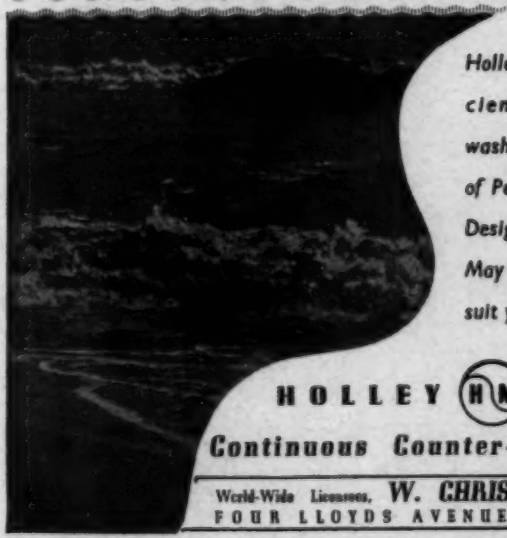

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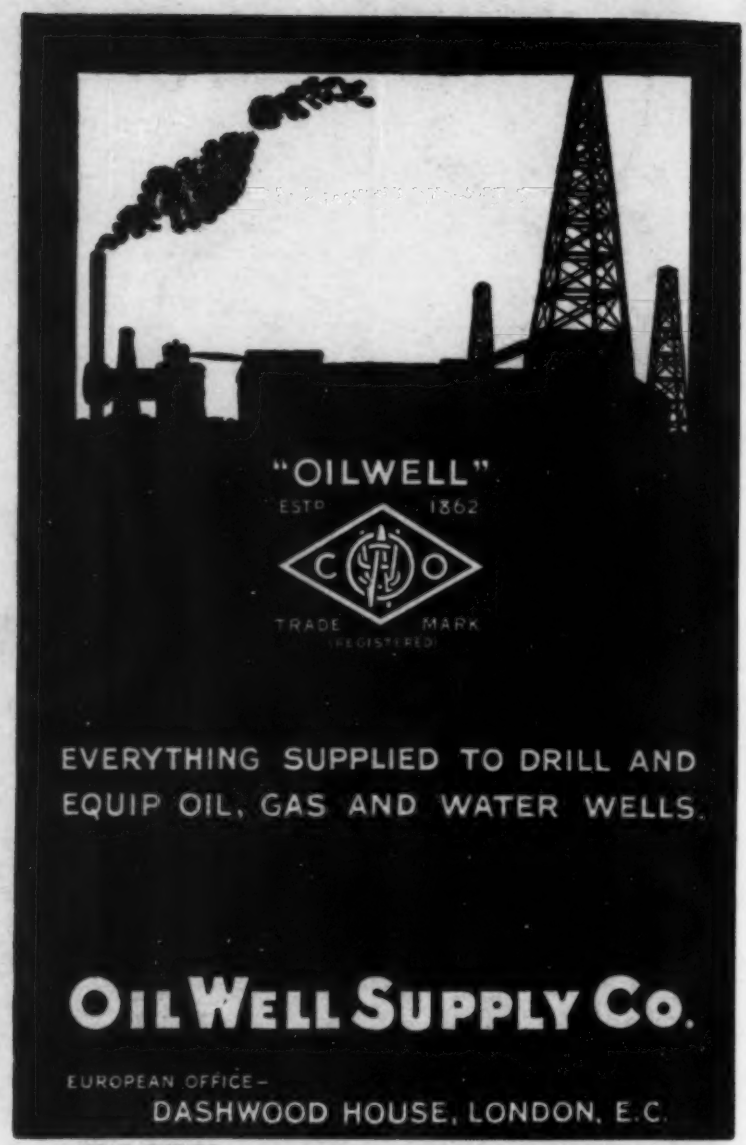

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